DECEMBER, 1934.

GENERAL PHYSICS.

ADSORPTION.

4767. Complex Nature of the Surface of Wood Charcoal. A. King and C. G. Lawson. *Kolloid Zeits.* 69. *pp.* 21–30, *Oct.*, 1934.—The preparation, structure and activation of pure wood charcoal are discussed, especially with respect to the nature of the surface. The proof of the chemisorption of O_2 by the charcoal is outlined, and the chemical activity of this O_2 described. Various other well-known effects such as those with CO and water are also dealt with. A series of wood charcoals have been prepared and activated in a stream of O_2 from 170° to 900°; a definite amount of oxalic acid was obtained in each case, and the mechanism of its formation is discussed. It is shown by analysis that the peroxide content which may be extracted from pure wood charcoal is less than 10^{-5} gm. per gm. of charcoal, and therefore cannot be responsible for the catalytic activity observed. H. H. Ho.

4768. Swelling of Charcoal. Part III. Adsorption of Lower Alcohols. D. H. Bangham, N. Fakhoury and A. F. Mohamed. *Roy. Soc., Proc.* 147*A*. *pp.* 152–175, *Nov.* 1, 1934.—Using the apparatus, technique, and pinewood charcoal rod described in Part II [see Abstract 5 (1933)], adsorption-expansion measurements have been made with the series of lower alcohols. The view that the expansion is proportional to the surface pressure in the adsorbed phase is confirmed. The Gibbs equation is accurately valid for EtOH and MeOH, except in the region of low pressures, where two breakpoints occur in the 0° C. isothermal of the latter substance. The four lowest straight-chain alcohols form two distinct types of film (the " primary " and the " annealed "); transition from the former to the latter proceeds more rapidly at high temperatures than at low. A comparison of the expansion data with those for the lowering of the surface tension of mercury by the vapours of the same alcohols permits estimates to be made of the specific surface of the charcoal, and of the expansion per dyne increase of surface pressure. For a given adsorption value, the branched-chain alcohols give rise to larger expansions than their straight-chain isomers, and they are characterised also by a much slower rate of adsorption. Tertiary butyl alcohol was not adsorbed by the charcoal used. [See following Abstract.] H. H. Ho.

4769. Swelling of Charcoal. Part IV. Stoichiometric Relations for the Films of the Alcohols. D. H. Bangham. *Roy. Soc., Proc.* 147*A*. *pp.* 175–188, *Nov.* 1, 1934.—With the annealed films of the first four straight-chain alcohols, the quantities of each alcohol giving rise to equal expansions of the charcoal were found to be approximately equal. The same applies, according to the data of Cassel and Salditt, to the adsorbed quantities of these alcohols having equal effect on the surface tension of mercury, provided that the surface concentration is sufficiently great. A comparison of the curves for the films on mercury with the corresponding molecular expansion graphs derived from the charcoal data shows that on mercury also there occurs, with rise of concentration, a transition from the primary to the annealed type of film. The primary films are probably uni-molecular, whilst the thickness of the annealed films is about equal to that of two carbon chains. The state of aggregation of the annealed films is discussed, and it is shown that, in those of the normal alcohols, the intermolecular forces are operative mainly in the direction of the normal to the surface. On the basis of certain simplifying assumptions, values are calculated for the coefficients of compressibility and of dilatation of the annealed films of the normal alcohols. [See preceding Abstract.] H. H. Ho.

4770. Chemisorption on Charcoal. Influence of Activation on the Sorption of Water Vapour. A. King and C. G. Lawson. *Faraday Soc., Trans.* 30. *pp.* 1094–1103, *Nov.,* 1934.—The adsorption of water vapour by four charcoals, activated in different manners by oxygen, has been measured at various humidities and isotherms drawn. The effect of the temperature of activation of charcoal in oxygen on the magnitude and rate of adsorption of water vapour at 75 per cent relative humidity has been studied and also the effect of the speed of the oxygen flow during activation as well as of storing the charcoals in air. The adsorption of iodine, acetic acid and ammonia has been measured on five selected charcoals activated at different temperatures. The whole of the experimental data is correlated on the hypotheses of the existence of two specific surface oxides of carbon, one formed at about 400° and of acidic nature, the other existing at higher temperatures. AUTHORS.

4771. Sorption of Vapours by Ferric Oxide Gel. Part I. Aliphatic Alcohols. A. G. Foster. *Roy. Soc., Proc.* 147*A*. *pp.* 128–140, *Nov.* 1, 1934.—Isothermals of methyl, ethyl, normal and iso-propyl, and normal butyl alcohols on ferric oxide gel have been determined at 25° C. All are reproducible and show a large hysteresis loop which extends over almost half the entire range. The relative pressures at which hysteresis occurs diminish with increasing molecular weight, but the capillary radius (calculated by means of the Kelvin equation from the pressure at the point of inflexion in the desorption curves) remains constant, the average value being about 22 Å. The amounts of the various alcohols held at one-hundredth of the saturation pressure are proportional to their molecular weights and correspond approximately to 0·0011 gm. mol. per gm. of gel. This amount is assumed to represent the formation of a unimolecular layer on the surface of the pores. With butyl alcohol, this process is followed almost immediately by capillary condensation, but with the smaller molecules there exists an intermediate stage in the sorption process which may represent the partial formation of a second layer. H. H. Ho.

4772. Adsorption of Oxygen on Platinum, Iron Oxide and Chromium Oxide. B. Neumann and E. Goebel. *Zeits. f. Elektrochem.* 40. *pp.* 754–764, *Nov.,* 1934.—Adsorption isotherms are observed for O_2 on Pt (20° to 400° C.), on iron oxide (20° to 400° C.), and on chromium oxide (20° and 65° C.). For the oxides the adsorption is reversible and the isothermals reproducible, except for chromium oxide at 65° C. when chemical reaction occurs. For Pt the isothermals are reproducible, reversible at the lower temperatures (20° and 100° C.), but irreversible at the higher temperatures (200° to 400° C.). This irreversible character is due to the occurrence of a process other than adsorption, probably solution of atomic oxygen in the metal. The measured values are compared with those calculated from the equations of Freundlich and of Langmuir. The correspondence is generally good, the Langmuir equation giving the better agreement except for chromium oxide. Very rough determinations of the heats of adsorption for the oxides give results considerably higher than those calculated from the isothermals. L. A. W.

4773. Velocity of Adsorption of Hydrogen and Deuterium by Chromic Oxide. H. W. Kohlschütter. *Zeits. f. phys. Chem.* 170. *Abt.A.* 3–4. *pp.* 300–308, 1934.—For use in hydrogenation reactions, H and D are absorbed by active (water-containing) chromic oxide at 184° C. and 1 atmosphere pressure with equal velocities. At this temperature rapid interchange occurs between the D and the H present as water in the chromic oxide. By protracted action of D the adsorbent is transformed into chromic oxide poor in H but containing D. Under the conditions employed, the velocities with which H and D are taken up by this material show no difference. The bearing of these results on the theoretical and experimental treatment of activated adsorption processes and on their application to preparative investigations is considered. T. H. P.

4774. Adsorption of Water by Silica Gel and Examination of Patrick's Adsorption Formula. R. C. Ray and P. B. Ganguly. *Faraday Soc., Trans.* 30. *pp.* 997–1006, *Nov.*, 1934.—Adsorption isotherms of water vapour on silica gel have been determined at 32° C. and 40° C. The results agree fairly well with the Freundlich empirical formula except at pressures approaching saturation. Patrick's adsorption formula is found to be inadequate in explaining the adsorption of water vapour even at high temperatures where the change of viscosity of water with pressure becomes normal. It has been shown that in Patrick's formula, the constants which should be independent of temperature and the nature of the substance adsorbed, vary not only with different adsorptives but also with the same adsorptive at different temperatures. Consequently the utility of the Patrick adsorption formula is greatly diminished. The heats of wetting of silica gel containing varying quantities of water have been measured. It is found that the heat of wetting is intimately connected with the initial amount of water present in the gel. There is a linear relationship between the heat of wetting and the amount of water in the gel, the former being inversely proportional to the latter. When the gel is saturated with water, the heat of wetting becomes zero. At this point, the gel takes up approximately 37·5 per cent of water, and this amount is in exact stoichiometric relation of two molecules of water per molecule of silica. The facts that the heat of wetting is practically equal to the heat of adsorption and that an exact stoichiometric relation exists between water and silica at saturation appear to suggest the formation of an unstable adsorption compound.
AUTHORS.

4775. Disappearance of Hydrogen in the Presence of Potassium and Lithium Ion Sources. C. H. Kunsman and R. A. Nelson. *J. Chem. Phys.* 2. *pp.* 752–755, *Nov.*, 1934.—The disappearance of hydrogen in the presence of iron-alkali catalysts, sources of K^+ ions and a synthetic spodumene mixture, a source of Li^+ ions, was investigated. In these experiments, like those previously reported by the authors [see Abstract 4637 (1932)] no gas phase reaction was detected which could be attributed to the bombardment of hydrogen by positive ions with speeds up to 565 volts. It was concluded that all clean-up effects could be accounted for by reactions on or within the materials used as ion sources. AUTHORS.

4776. Catalytic and Electrical Properties of Metallic Surfaces. Part I. B. W. Bradford. *Chem. Soc., J. pp.* 1276–1283, *Sept.*, 1934.—Changes in the catalytic properties of a silver surface for the combustion of CO have been correlated with its electrical properties. A remarkable increase in the activity of Ag for this reaction occurs at temperatures above 510° C., and this enhanced activity persists at lower temperatures.

These changes are accompanied by parallel changes in electrical properties, the surface potential being increased. It is suggested, therefore, that above 510° C., surface vitrification occurs, because the polishing of a metal surface leads to an increase in the magnitudes of their Volta potentials. F. J. W.

See also Abstracts **4796, 4805, 4892.**

ATOMIC AND MOLECULAR STRUCTURE.

4777. Constitution of Atomic Nuclei. Part II. K. Guggenheimer. *J. de Physique et le Radium,* 5. *pp.* 475–485, *Sept.,* 1934.—Assuming elements to be made up of protons (P) and neutrons (N), and that the energy of binding an additional P or N is related logarithmically to the relative abundance of the element so formed compared with that of the one from which it is formed, various deductions are made: the energy of binding an additional N is usually greater when the added N makes the total number of N in the nucleus even than when it makes it odd, and similarly for P in an isotonic series; there exists therefore a definite tendency to the formation of N–N and P–P pairs, a conclusion supported by the greater number of elements with even numbers of both P and N as compared with that of elements with one or other, and still more with both, these numbers odd; the mutual affinity of Ns (or Ps) increases with the number of Ps (or Ns) already in the nucleus; there is no evidence of Ps and Ns uniting to form α-particles in the nucleus; among radioactive elements stability increases with the number of N (that of P remaining constant), but decreases with increase in number of P (N constant). [For Part I see Abstract 3074 (1934).] C. A. S.

4778. Binding Energy of Nuclei. L. Strum. *Phys. Zeits. d. Sowjetunion,* 6. 1–2. *pp.* 30–52, 1934. *In German.*—The mass defect of a nucleus is considered as the sum of two mass defects, *viz.,* (1) the "inner" mass defect, which is the sum of the mass defects of the constituent particles and (2) the "outer" mass defect which represents the binding energy of the nucleus. Assuming that nuclei are constructed from protons and neutrons only, the values of the outer mass defect are calculated for a large number of elements. By plotting this against the number of particles contained in the nucleus, a number of regularities are observed and the rules deduced from these are used to predict the occurrence of a number of other isotopes. J. E. R. C.

4779. Genesis of the Elements. G. N. Lewis. *Phys. Rev.* 46. *pp.* 897–901, *Nov.* 15, 1934.—The hypothesis is suggested that a great part of the matter in the universe is composed chiefly of iron and nickel, like the metallic meteors, and that such material, which is thermodynamically stable with respect to all spontaneous transmutations, except at extremely high temperatures, is superficially attacked by cosmic radiation to produce the material represented by the earth's crust and by the stony meteors. As a test of this hypothesis of the genesis of stony meteors from metallic meteors, a comparison is made of the relative abundance of the chief atomic species in the two types of meteors. The striking results of this comparison strongly indicate a genetic relationship. Three main disintegration processes to which the iron and nickel nuclei are subjected seem to be the splitting off of oxygen from these nuclei; the splitting of the nuclei into two identical parts; and the splitting of helium from the products of the preceding process. AUTHOR.

4780. Energy Spectrum of Positrons from Radio-Phosphorus $_{15}P^{30}$ (Activated Aluminium). Y. Nishina, R. Sagane, M. Takeuchi and R. Tomita. *Inst. Phys. and Chem. Research, Tokyo, Sci. Papers, No.* 524. [7 *pp.*], *Sept.*, 1934. *In English.*—The energy spectrum of positrons from radio-phosphorus, which is produced by activating aluminium with radon tubes, is studied by means of the Wilson cloud chamber placed in a uniform magnetic field. 735 pairs of exposures were made and 1484 tracks measured. The spectrum extends up to about $4 \cdot 0 \times 10^6$ eV. The spectrum seems to show more than one intensity maximum, the positions of which seem also to change with time after activation. Although the probability of such occurrence through mere statistical fluctuations is small, any definite conclusion as to the real existence of the last features must be reserved for further investigations. AUTHORS.

4781. Disintegration of Boron by α-Particles. H. Miller, W. E. Duncanson and A. N. May. *Cambridge Phil. Soc., Proc.* 30. *pp.* 549–560, *Oct.* 30, 1934.—The protons emitted from boron, when it is bombarded by α-particles from radium C′ and polonium, have been examined. All have been ascribed to the disintegration of the B^{10} isotope following the capture of an α-particle. Four energy changes with values 3·1 M.V., 0·4 M.V., − 0·1 M.V., and − 1·0 M.V. are necessary to explain the range distribution observed. Experiments with α-particles from polonium also show that penetration through the top of the potential barrier stops at an energy of 3·6 M.V. and that below this there is a resonance level at about 2·9 M.V. [See Abstract 3976 (1934).]

AUTHORS.

4782. Probability of Artificial Nuclear Transformations and its Connection with the Vector Model of the Nucleus. M. Goldhaber. *Cambridge Phil. Soc., Proc.* 30. *pp.* 561–566, *Oct.* 30, 1934.—The theorem of quantum mechanics that " the spin part of the angular momentum is approximately a constant of motion provided that the forces depending on the direction of the spins are small compared with the total interaction forces " is introduced into the discussion of artificial nuclear transformations. A definition is given for the terms " probable " and " not probable " nuclear reaction. Attention is drawn to the experimental result that the reaction $Li^6 + H^1 \rightarrow He^4 + He^3$ is more probable than the reaction $Li^7 + H^1 \rightarrow 2He^4$, and an explanation is suggested. The nuclear spin of Li^6 is derived from nuclear transformations and found to be 1. Similar derivations for the spins of H^3, He^3 and B^{11} are summarised in a table.

AUTHOR.

4783. γ-Rays Accompanying Artificial Nuclear Disintegrations. E. McMillan. *Phys. Rev.* 46. *pp.* 868–873, *Nov.* 15, 1934.—γ-rays have been observed from the bombardment of F, Li and possibly B and Be by 1·15 m.e.V. protons, and γ-rays and neutrons in varying proportions from the bombardment of Be, C, Li, B and possibly F, Li, Mg and Al by 2·3 m.e.V. deutons. Studies have been made of the excitation function and of the absorption of some of these radiations, and also of the absorption of the " annihilation radiation " accompanying the radioactivity stimulated in carbon. The γ-ray from F bombarded by protons is of especial interest, since it furnishes an experimental check of the pair-production absorption at the high quantum energy of 5·4 m.e.V., where the pair-production accounts for more than half of the total absorption in lead.

AUTHOR.

4784. Scheme of Isotopes. J. Mattauch. *Zeits. f. Physik.* 91. 5–6. *pp.* 361–371, *Oct.* 5, 1934.—For stable isotopes a selection rule is given. No isobars are obtained for isotopes of odd atomic number or odd atomic weight. Outstanding exceptions to this rule are isotopes whose existence cannot be regarded as too certain by experimental methods. By means of the selection rule hitherto undetected isotopes are predicted and fall into the scheme; but no place can be found for elements 43 and 61. Elements with even atomic number are also considered and their isotopes fitted in the scheme. W. R. A.

4785. Separation and Transmutation of the Isotopes of Lithium. M. L. Oliphant, E. S. Shire and B. M. Crowther. *Roy. Soc., Proc.* 146*A*. *pp.* 922–929, *Oct.* 15, 1934.—A description is given of the methods used to separate the isotopes of lithium in quantities of the order of 10^{-8} gm. The completeness of the separation effected, and the possibility of using such small quantities of material for definite experiments on the transmutation effects observed during bombardment by protons and by ions of heavy hydrogen, is confirmed by the further experiments described. In these the targets were mounted and bombarded with hydrogen ions at about 160,000 volts energy, and the particles emitted were examined. The results are summarised in the following table :—

Bombarding particles	Lithium 6	Lithium 7
Protons	α-particles of 11·5 mm. range	α-particles of 8·4 cm. range
Diplons	α-particles of 13·2 cm. range Protons of 30 cm. range	α-particles up to 8 cm. range Neutrons

AUTHORS.

4786. Relative Abundance of the Isotopes of Lithium, Potassium and Rubidium. A. K. Brewer and P. D. Kueck. *Phys. Rev.* 46. *pp.* 894–897, *Nov.* 15, 1934.—The abundance ratios of the isotopes of lithium, potassium and rubidium have been measured with a Dempster type mass spectrograph. Artificial aluminium silicates of these alkalis were used as the source of ions. An abundance ratio of 12·14 ± 0·4 was obtained for Li^7/Li^6. On the basis of this ratio the masses of the two isotopes are 7·016 ± 0·002 and 6·016 ± 0·002 and the packing fractions are 23 ± 3 and 26 ± 3 respectively. The observed abundance ratio for potassium is $K^{39}/K^{41} = 13{\cdot}88 \pm 0{\cdot}4$. This value gives 38·96 ± 0·003 and 40·96 ± 0·003 for the masses of the two isotopes, and − 9·85 ± 0·9 and − 9·37 ± 0·9 for their respective packing fractions. A ratio of $Rb^{85}/Rb^{87} = 2{\cdot}59 \pm 0{\cdot}04$ was obtained for rubidium. On the basis of 85·44 for the atomic weight the masses of the isotopes come out to be 84·88 and 86·88 while the corresponding packing fractions are − 14·1 ± 0·7 and − 13·8 ± 0·7. The values for the packing fractions given above fall fairly closely on the packing fraction *vs.* mass number curve given by Aston for lithium and potassium but are about 70 % low for rubidium. AUTHORS.

4787. Possibility of Separating D_2O from H_2O by Fractional Freezing. G. Bruni. *Accad. Lincei, Atti,* 20. *pp.* 73–75, *Aug.*, 1934.—Doubt being felt concerning the accuracy of the results described by

Bruni and Strada [see Abstract 2678 (1934)], the experiments have been repeated by A. Quilico. By removal of ice in nine distinct operations, 4000 l. of water were reduced finally to 280 c.c. Examination of the final product failed to give any indication of any appreciable enrichment of the water in D_2O. To explain this behaviour, which differs from that of other isomorphous substances, it is pointed out that the lattice dimensions of water are determined almost entirely by the O, the small H or D ions finding positions in the empty spaces. Thus, the two substances, H_2O and D_2O, behave virtually as one in the crystalline lattice and are not differentiated in the freezing. T. H. P.

4788. Investigation of the Isotopes of Oxygen and Hydrogen with the Mass Spectrograph. H. Muckenthaler. *Phys. Zeits.* 35. *pp.* 851–857, *Nov.* 1, 1934.—A mass spectrograph of the Thomson parabola type was used to determine the ratio O^{18}/O^{16}. The results differ widely among themselves, the mean being **1/1058 ± 69**, a value which is in fair agreement with band spectra determinations but which differs widely from the result obtained by Mecke and Childs [see Abstract 2294 (1931)] with a mass spectrograph. By diffusion through Pd it was shown that the heavier isotope H^2 could be enriched, as shown by the mass spectrograph, to 15 times its normal concentration in electrolytic hydrogen. Aston's observation that the oxygen lines are very prominent in the presence of helium was not confirmed. Photographs of the parabolæ obtained are reproduced. F. C. C.

4789. Fractionation of the Isotopes of Hydrogen and of Oxygen in a Commercial Electrolyser. E. W. Washburn, E. R. and F. A. Smith. *Bureau of Standards, J. of Research,* 13. *pp.* 599–608, *Nov.,* 1934. —The electrolytic fractionation of the isotopes of H and of O under the conditions prevailing in a commercial hydrogen-oxygen electrolyser have been followed by means of measurements of density. Upon electrolysis of ordinary water, the change in its density at the beginning is caused as much by the fractionation of O as of H. Curves showing the course of the fractionation of the separate isotopes are given. After an amount of water approximately equal to 10 times the volume of a commercial alkaline cell has been electrolysed, a steady state is closely approached in which no further isotopic fractionation occurs. In this state the gases evolved have the isotopic composition existing in the water added to the cell, and the residual water left in the cell is 60 ppm. heavier than ordinary water. Of this 60 ppm., 28 are contributed by the heavy isotope of H, indicating an electrolytic fractionation factor of 2·4 under the conditions described. AUTHORS.

4790. Geochemical Aspects of the Location of Heavy Water. W. Vernadsky. *Comptes Rendus,* 199. *pp.* 694–696, *Oct.* 15, 1934.—The influence on the location and concentration of heavy water in natural waters is considered for the case of geological time—disappearance of glaciers, drying up of inland lakes and the resulting formation of deposits of hydrated salts, liberation of steam in volcanic eruptions; the action of gravitation; the phenomenon of metamorphism. N. M. B.

4791. Chemical Forces from the Standpoint of Quantum Mechanics. H. Hellmann and W. Jost. *Zeits. f. Elektrochem.* 40. *pp.* 806–814, *Nov.,* 1934.—This theoretical paper, which should be consulted in its entirety, deals with the interpretation of the homopolar forces binding atoms together, and also the forces of repulsion between atoms, molecules and ions. In an Appendix the relations established in the paper are also derived from the Fermi statistics for null point energy and electronic pressure. H. H. Ho.

4792. New Electroaffinity Scale, with Data on Valence States, Valence Ionisation Potentials and Electron Affinities. R. S. Mulliken. *J. Chem. Phys.* 2. *pp.* 782–793, *Nov.*, 1934.—A new approximate "absolute" scale of electronegativity, or electroaffinity, is set up. The absolute electroaffinity on this scale is equal to the average of ionisation potential and electron affinity. These quantities must, however, in general, be calculated not in the ordinary way, but for suitable "valence states" of the positive and negative ion. Also the electroaffinity of an atom has different values for different values of its valence; in general the electroaffinity as here calculated (in agreement with chemical facts) is larger for higher valences. Electroaffinity values have been calculated here for H, Li, B, C, N, O, F, Cl, Br, I. They show good agreement in known cases with Pauling's electronegativity scale based on thermal data, and with the dipole moment scale. The present electronegativity scale (like the others) is rather largely empirical, especially as to its quantitative validity; and it remains to be seen whether or not the latter will be more than very rough when tested for a wider range of cases. Nevertheless the new scale has a theoretical foundation which throws new light on the physical meaning of electronegativity (or electroaffinity). The basis of the present scale is simpler and more certain for univalent than for polyvalent atoms. The nature of valence states of atoms is briefly discussed. The tabulations of atomic valence state energies and valence state ionisation potentials and electron affinities may be useful in problems of molecular structure. AUTHOR.

4793. Molecular Polarisation and Association. K. L. Wolf and W. Herold. *Zeits. f. phys. Chem.* 27. *Abt.B.* 1–2. *pp.* 58–70, 1934.—The association of methyl, ethyl, propyl and butyl alcohols in benzene and hexane is discussed. The theory is worked out for two types of association: (*a*) simple and double molecules, and (*b*) more complex molecules. Agreement with experimental values is qualitatively good. W. R. A.

4794. Free Alkali Metals. H. Alterthum and R. Rompe. *Phys. Zeits.* 35. *pp.* 814–836, *Oct.* 15, 1934.—This review of recent work (1930–1933) on the alkali metals deals with: (1) nuclear properties such as atom weights, mechanical and magnetic moments of the nucleus, nuclear transformations such as radioactive and artificial changes; (2) properties of the electronic sheath of atoms and molecules; (3) behaviour of atoms and molecules in the gaseous phase with respect to fluorescence, velocity of particles and gaseous discharge; (4) properties of the disperse states including colloidal, optical, photoelectrical, thermal electronic, and ionic emissions, molecular diffusion in layers, solution capacity in liquid media and reactivity; (5) properties of the massive metals such as structure, thermal, electrical and magnetic characteristics; (6) suitable laboratory methods of preparation. The paper contains a most comprehensive set of references to original publications. H. H. Ho.

See also Abstracts 4773, 4834, 4880, 4881, 4898, 4984, 4985, 5038, 5039, 5040, 5041, 5046, 5061, 5062, 5071, 5072, 5128, 5129, 5130, 5131, 5136, 5137, 5192, 5234, 5251.

COLLOIDS.

4795. Alteration of Hydrophobic Sols by Light in Relation to their Natural Stability. W. Heller. *Comptes Rendus*, 199. *pp.* 723–724, *Oct.* 15, 1934.—The case is considered where the photochemical action is on the adsorbed electrolyte. Here coagulation is probably due to the critical diminution of the double layer, in which case the effect of light should be greater as the double layer is initially weaker. Sols of Fe_2O_3 obtained by hydrolysis of $Fe(NO_3)_3$ were dialysed for periods of 3 to 25 days, and examined magneto-optically after varying periods in darkness and then one of exposure to diffused light. The rate of growth of size of particles decreased with time while in darkness, but increased again on exposure to light, the increase being greatest in the sols longest dialysed, and so least stable. [See Abstracts 587 and 3997 (1934).] C. A. S.

4796. Cataphoresis of Gliadin. Parts I and II. I. Kemp and E. K. Rideal. *Roy. Soc., Proc.* 147*A*. *pp.* 1–24, *Nov.* 1, 1934.—In Part I, from the distribution curves of gliadin molecules over the surface of suspended quartz particles, it appears that preferential adsorption of gliadin occurs at the gliadin-liquid interface. The velocity of adsorption of gliadin molecules at the surface of suspended quartz particles is shown to be unimolecular. The velocity depends upon magnitude and sign of the charge on the gliadin molecule. From this relationship the electrical work function at the quartz liquid interface is shown to be of the order of the measured electrokinetic potential. In Part II the acid and basic dissociation constants of gliadin are calculated from mobility-*p*H curves and from titration data. The isoelectric point of gliadin depends upon the concentration of electrolyte. From this variation the numbers of acetate ions adsorbed per molecule of gliadin are calculated. The Debye-Hückel-Henry expression for cataphoretic velocity is applicable to the systems investigated only over a limited range of concentrations ($\mu = 0{\cdot}008 - 0{\cdot}013$). For more concentrated solutions a correction for adsorption of ions becomes necessary. Application of this correction leads to a satisfactory agreement with theory for strong solutions. For more dilute solutions, it becomes necessary to take into account the fact that the effective surface charge on the protein is decreasing owing to the existence of a Donnan ionic equilibrium between ions inside and outside the double layer. AUTHORS.

4797. Intensity of Tyndall Light for Gold Hydrosols. H. Rinde. *Kolloid Zeits.* 69. *pp.* 1–11, *Oct.*, 1934.—A method is described for determining the ratio between the intensity of the Tyndall light and that of ultra-violet incident light. The influence of absorption was eliminated by a graphical method. The intensity of the Tyndall light is proportional to the concentration of the gold colloid and to the depth of the Tyndall cone. Using the germ method with prepared gold hydrosols, the Tyndall light is fairly feeble within a range of 440–330 $m\mu$, but from 300–270 $m\mu$ it grows to a high maximum. The intensity of the Tyndall light is remarkably small for fine-grained sols but increases rapidly with increase of particle size. If the gold concentration be kept constant, the strongest Tyndall light is obtained with particles of radius 40–50 $m\mu$. H. H. Ho.

4798. Viscosimetric Investigations on the Structural Formation of V_2O_5 Sols. Part I. A. Rabinerson. *Kolloid Zeits.* 69. *pp.* 66–73, *Oct.*, 1934.—Study of the pressure-viscosity curves on several successive days shows that the principal factor of the structure-viscosity of aged V_2O_5 sols with no addition of electrolyte is the rod shape of the colloidal particles. To this is added the influence of particle-aggregates, which condition slight hysteresis. With concentrated V_2O_5 sols in presence of a coagulant which is not too effective, typical viscosity thixotropy appears, the cause of the structure-viscosity being probably the formation of orientated coagulation structures. In presence of more active coagulants and with lower V_2O_5 content, the curves obtained with aged sol-electrolyte mixtures indicate that the structure-viscosity here depends mainly on non-arranged coagulation structures. T. H. P.

4799. Surface Relationships of Ferric Oxide by the Emanation Method. O. Hahn and Vera Senftner. *Zeits. f. phys. Chem.* 190. *Abt.A.* 3–4. *pp.* 191–211, 1934.—The emanation method serves to indicate the changes in structure and surface occurring when preparations of ferric oxide are heated. As adsorbed water is given up, gradual shrinking occurs. More rapid diminution of surface takes place at 400° C., which is the temperature of "Verglimmen" of the oxide. Above 400°, the preparations still contain small amounts of water enclosed in the lattice, this being expelled only at 850–900°. This included water varies in different preparations, being relatively high in amount in a ferric oxide gel aged under water and almost zero in alcogels. On expulsion of this water, recrystallisation of the oxide occurs as a result of mechanical loosening. Heating to still higher temperatures effects a lattice-loosening conditioned by the increased molecular motion. Mixed preparations made by co-precipitation of iron and aluminium hydroxides behave differently according as mixed crystals are or are not formed. Thorium oxide gels behave similarly to those of ferric oxide, but, as might be expected, thorium oxalate shows quite different behaviour. T. H. P.

4800. Supersaturation Theory of the Space-and Time-Intervals of Liesegang's Precipitates. H. Bauer. *Zeits. f. phys. Chem.* 27. *Abt.B.* 1–2. *pp.* 145–160, 1934.—Modifications are suggested in the theory previously outlined [see Abstract 4313 (1933)]. The experimental data of Morse and Pierce [Abstract 663 (1904)] are subjected to thorough examination and recalculation and are found to be in satisfactory agreement with the author's amended theory. T. H. P.

See also Abstracts 4768, 4769, 4794.

CRYSTAL STRUCTURE AND PROPERTIES.

4801. Theory of Linear Crystallisation Velocity. R. Kaischew and I. N. Stranski. *Zeits. f. phys. Chem.* 170. *Abt.A.* 3–4. *pp.* 295–299, 1934.—Following on their earlier work [see Abstract 2714 (1934)], the authors now consider the case of linear crystallisation velocity, for which an expression differing from that of Volmer and Marder [see Abstract 2728 (1931)] is derived. The deviations between the experimental and theoretical velocity-temperature curves are discussed. T. H. P.

4802. Lineage Structure of Crystals. M. J. Buerger. *Zeits. f. Krist.* 89. 3–4. *pp.* 195–220, *Oct.*, 1934. *In English.*—A crystal is considered to be internally partitioned by discontinuities in such a way that the entire structure is continuous but branched. These branches are termed lineages. The mosaic appearance of crystal is due to sectioning across lineages. Lineage structure is advanced as an alternative to Zwicky's secondary structure, and many phenomena are explained on this hypothesis. Among these may be mentioned the occurrence of plastic deformation by gliding and the phenomenon of work-hardening. J. T.

4803. Mosaic Structure in Crystals. H. E. Buckley. *Zeits. f. Krist*, 89. 3–4. *pp.* 221–241, *Oct.*, 1934. *In English.*—The different types of mosaic are reviewed: of these, those of Smekal and Zwicky rest without reliable experimental basis and their theoretical conclusions have been disputed. The Darwin mosaic rests upon the evidence of X-ray reflection from crystal surfaces. A number of experimental facts are given which show the difficulty of accepting the mosaic theory. The theory is discussed in the light of crystal-growth, cleavage, etc. AUTHOR.

4804. Secondary Structure in Crystals. M. J. Buerger. *Zeits. f. Krist.* 89. 3–4. *pp.* 242–265, *Oct.*, 1934. *In English.*—No experimental results have been brought forward which require a secondary structure in crystals for their explanation. The observations alleged to require a secondary structure are manifestations of well known crystallographic phenomena. Secondary structures of the general Zwicky type are quite unable, in general, to explain observed gliding and cleavage, and therefore are incapable of giving explanation to plastic deformation and rupture. Zwicky's particular secondary structure thus fails to accomplish its first objective. There is no discrepancy between calculated and observed strengths of crystals. Secondary structures developed by obtaining energy from the contraction of certain planes are impossible. Calculations predicting such a structure have completely omitted the important energy term involving the expansion at right angles to the contracting plane. Taken into account, this rules out any secondary structure based on this principle, as well as Zwicky's particular variety of secondary structure. AUTHOR.

4805. Internal Adsorption in Crystals. D. Balarew. *Zeits. f. Krist.* 89. 3–4. *pp.* 268–281, *Oct.*, 1934.—Internal adsorption in crystalline salts is bound up with their mosaic structures. From chemical experiments it is concluded that a real crystal is a conglomerate. J. T.

4806. Intensities of X-Ray Spectra and Imperfections of Crystals. R. W. James. *Zeits. f. Krist.* 89. 3–4. *pp.* 295–309, *Oct.*, 1934. *In English.*—There are two extremes to consider : at one end the perfect crystal, reflecting X-rays so that the intensity is proportional to the structure amplitude ; and at the other end, a mosaic crystal to each region of which a simple reflection formula is applicable. An integrated reflection expression is obtained. Primary and secondary extinction is considered, and a discussion concerning the evidence of the sweep-curves for degrees of structural imperfection concludes the paper. F. I. G. R.

4807. Group-Phenomena in Metal Crystals. A. Goetz. *Zeits. f. Krist.* 89. 3–4. *pp.* 310–326, *Oct.*, 1934.—A critical discussion of the experimental data which are claimed to be significant for distinguishing between "real" and "ideal" crystals. Also, the question of the validity of the assumption of a higher-order periodicity in the crystal, and the need of a hypothesis of molecular aggregates are considered. F. I. G. R.

4808. Mechanical Cohesion Properties and the "Real" Structure of Crystals. E. Orowan. *Zeits. f. Krist.* 89. 3–4. *pp.* 327–343, *Oct.*, 1934.—It appears that friction, plastic gliding and electrical rupture are phenomena of a labile nature which cannot be theoretically accounted for on the assumption of a completely homogeneous lattice. A theory of spreading cracks is sufficient for an explanation of cohesion properties. F. I. G. R.

4809. Theory of the Real Crystal. A. Smekal. *Zeits. f. Krist.* 89. 3–4. *pp.* 386–399, *Oct.*, 1934.—A connected summary of work already published, or in the press, of the author and others regarding the effect of impurities on irregularities of crystal structure, with special reference to plasticity, cohesion, cleavage, the distinction between elastic and yield (*streck*) limits, internal (*selbst*) diffusion, and recrystallisation, with a description of the mechanism of these phenomena. C. A. S.

4810. Evidence for Upper Limit of 500 Å to Dimensions of Mosaic Blocks in a Crystal. H. E. Buckley. *Zeits. f. Krist.* 89. 3–4. *pp.* 410–415, *Oct.*, 1934. *In English.*—Tabular crystals, often grown in presence of much "impurity," or cleavage flakes, including such of the "ideally imperfect" crystals barytes, fluor, or gypsum, are described, giving in monochromatic light regular parallel interference figures spaced proportionally to the wave-length within the crystal of the incident light. This regularity seems inconsistent with the theory of a mosaic structure unless the dimensions of the mosaic blocks do not exceed 500 Å. The only type of imperfection consistent with the present observations would seem to be M. J. Buerger's "lineages" [see *Amer. Min.* 17. 177, 1932]. C. A. S.

4811. Stability of the Ionic Lattice. G. Steensholt. *Zeits. f. Physik,* 91. 11–12. *pp.* 765–766, *Oct.* 23, 1934.—Energy curves show stability for the rock-salt lattice type, in agreement with experiment. F. I. G. R.

4812. Transformations in Homogeneous Substances. G. Tammann. *Zeits. f. phys. Chem.* 170. *Abt.A.* 5–6. *pp.* 380–390, 1934.—Transformations in crystallised substances may be divided into two classes, according as the transformation is accompanied by recrystallisation or takes place in a crystal which remains homogeneous. If recrystallisation occurs, the properties of the substance must change discontinuously at a definite temperature, whereas if the crystals remain homogeneous, the properties, and likewise their differential quotients, alter continuously in temperature-intervals. Various cases are considered. T. H. P.

4813. Importance of Cubic Face-Centred Lattice Structures in Causal Interpretation of their Relationships. R. Reinicke. *Zeits. f. phys. Chem.* 27. *Abt.B.* 1–2. *pp.* 28–36, 1934.—The cubic face-centred lattice is derived by identifying the centres of gravities of similar cubes (possibly as carriers of inscribed tetrahedra) placed edge to edge with the centres of gravities of the atoms. From the fact that, not only almost all noble gases, but also many metals form cubic face-centred crystals, it is concluded that, by losing their valency electrons, such metals break down into the noble gases adjacent to them in the periodic system of the elements. In opposition to the former view, rock-salt structure is regarded as a charge-lattice, from which it follows by analogy that the valency electrons split off occupy independent positions in the lattice structure. From the same standpoint close relationships may be deduced between the cubic face-centred lattice and other molecular structures. T. H. P.

4814. Structure of Aluminium Carbide. M. v. Stackelberg and E. Schnorrenberg. *Zeits. f. phys. Chem.* 27. *Abt.B.* 1–2. *pp.* 37–49, 1934.—From Laue, rotation and Weissenberg photographs it is found that the structure of Al_4C_3 is rhombohedral. The lattice constants are $a = 8 \cdot 53$ Å, and $\alpha = 22°28'$. The space group is D^5_{3d} and the unit cell contains one molecule. The atomic positions and interatomic distances are given. The structure is of the "layer-lattice" type. J. T.

4815. Structure of Beryllium Carbide. M. v. Stackelberg and F. Quatram. *Zeits. f. phys. Chem.* 27. *Abt.B.* 1–2. *pp.* 50–52, 1934.—From powder photographs it is found that the structure of Be_2C is of the fluorite type with $a = 4 \cdot 33$ Å. The interatomic distances are given. J. T.

4816. Structures of Carbides, Silicides, Nitrides and Phosphides of Electropositive Metals. M. v. Stackelberg. *Zeits. f. phys. Chem.* 27. *Abt.B.* 1–2. *pp.* 53–57, 1934.—The known carbides, silicides, nitrides and phosphides of electropositive metals can be satisfactorily considered to possess ionic lattices. The anions form a close-packed lattice the gaps being then filled up by a tetrahedral or octahedral arrangement of kations. J. T.

4817. X-Ray Reflection and "Real" Structure of Rock-Salt. M. Renninger. *Zeits. f. Krist.* 89. 3–4. *pp.* 344–374, *Oct.*, 1934.—In one sample (artificially prepared) the yet unknown small half-width (reflection) of 7·1″ was found. The integral reflective power accorded with dynamical theory for an "ideal" crystal. Still better agreement followed upon the introduction of Prins' absorption correction. F. I. G. R.

4818. Formation of Crystalline Compounds in the Hardening of Siliceous Cements. L. Chassevent. *Comptes Rendus,* 199. *pp.* 673–675, *Oct.* 8, 1934.—To examine the nature of setting of these cements without the complication caused in X-ray results by the presence of extraneous solid matter colloidal solutions of SiO_2 (0·84–6·4 gm./l.) were mixed with solutions of CaO (0·080–1·06 gm./l.); these were agitated out of contact with air for periods of 2 hr. to 7 days, and then examined by X-rays. The same crystalline compound, and one only, the hydrated monosilicate (CaO, SiO_2, $2{\cdot}5H_2O$), was found in all precipitates. C. A. S.

4819. Structure of Dibenzyl. J. Dhar. *Indian Journ. Phys.* 9. *pp.* 1–20, *Sept.*, 1934.—The paper gives an account of a detailed X-ray analysis of the structure of dibenzyl crystal. The benzene rings in the molecule are found to have a plane hexagonal structure, and they lie in parallel planes separated by about 0·23 Å. One of the aliphatic carbon atoms in the molecule lies in the prolongation of the line L joining the atoms 4 and 1, and the other on the line L′ joining 4′ and 1′. The line joining the two aliphatic carbon atoms themselves is found to be inclined at 109½° to each of the above two lines, L and L′. AUTHOR.

4820. Atomic Positions in p-Dinitrobenzene by Fourier Analysis Method. K. Banerjee. *Phil. Mag.* 18. *pp.* 1004–1008, *Nov.*, 1934. *Supplement.*—The planes of the NO_2 groups are found to be inclined to those of the benzene rings. $C - N = 1{\cdot}51$ Å, $N - O = 1{\cdot}43$ Å, $O - O = 1{\cdot}58$ Å. Uncertainties concerning the atomic factors preclude good agreement between calculated and observed structure factors. F. I. G. R.

4821. Significance of Vicinal Faces for Determining the Symmetry and Form-Development of Crystals. G. Kalb. *Zeits. f. Krist.* 89. 3–4. *pp.* 400–409, *Oct.*, 1934.—The faces of crystals as ordinarily accepted are really the limiting forms of the vicinal faces, which are the true surface phenomena of the crystal, and from which it is possible to determine the symmetry and development of the forms present thereon. This is illustrated from the vicinal faces on crystals of analcite, pyrite, apophyllite, and quartz. C. A. S.

4822. Lattice Optics of Active Crystals. G. Szivessy and C. Münster. *Ann. d. Physik,* 20. 7. *pp.* 703–736, *Sept.*, 1934.—The laws deduced by Ewald and Born for the propagation of light in any selected direction inside a non-absorbing active crystal are tested experimentally in α-quartz and are confirmed. The form of the gyration surface in α-quartz is also determined. C. B. A.

4823. Sensitisation of Photochemical Effect in Alkali-Halide Crystals. A. v. Lüpke. *Ann. d. Physik*, **21.** 1. *pp.* 1–14, *Oct.*, 1934.—Alkali-halide crystals exhibiting " U " bands can be produced by an electrolytic process during their production artificially from molten material. Weak " U " bands can also be obtained by diffusion of electrons in an electric field into finished crystals, but occasionally, strong bands are produced in this way. Attempts to elucidate the cause of this are described. When foreign substances are added to the melt, the crystals obtained exhibit a small photochemical sensitisation, and the absorption spectra of the foreign substances become altered during the process. Electron diffusion into the finished crystals in an electric field now produces a large photochemical effect. Evidence is adduced to show that this is due to the electrons arranging themselves round the foreign molecules in the lattice. The experiments also indicate that it is an excess of the metal kation which is effective in producing " U " bands. The dependence of these bands on temperature is investigated further. C. B. A.

4824. Photochemical Properties of Synthetic Rock-Salt Crystals. Displacement of Colour Absorption Bands towards the Red by Deformation. K. Helbig. *Zeits. f. Physik*, **91.** 9–10. *pp.* 573–592, *Oct.* 14, 1934.—By means of repeated colorisation, by irradiation with ultra-violet light, and subsequent photochemical decolorisation, it is shown that the " colorisability " of previously untreated synthetic rock-salt crystals can be increased to a definite maximum. The effect is brought about by irreversible changes in the defects of the crystal structure, and the maximum corresponds to the transition of the structure into a state of stable equilibrium. On the other hand, a similar, weaker effect in crystals coloured by X-ray irradiation depends on disturbance of the interior of the crystal by the large X-ray quanta, and can be made reversible. Experiments on plastically deformed crystals lead to the following conclusions: (*a*) The photochemical : photoelectric equilibrium state of a crystal is disturbed by plastic deformation ; (*b*) the velocity of decolorisation of such crystals is larger than that in undeformed crystals ; (*c*) deformation causes a shift towards the red of the absorption bands producing the colour. A quantitative relationship between this shift and the rigidity of the lattice can be established. [See following Abstract.] C. B. A.

4825. Colour Centres and Plastic Deformation of Synthetic Rock-Salt Crystals containing Foreign Atoms. E. Poser. *Zeits. f. Physik*, **91.** 9–10. *pp.* 593–599, *Oct.* 14, 1934.—It is shown that the photochemical-elastic limits of synthetic rock-salt crystals, and the displacement of the absorption band producing colour towards the red which results from large plastic deformations, are independent of the presence of foreign molecules ($SrCl_2$) in the crystal lattice, although the presence of these impurities leads to a marked increase in mechanical rigidity of the lattice. [See preceding Abstract.] C. B. A.

4826. Surface of Birefringence and the Singular Property of Some Crystal Plates. C. Gaudefroy. *Comptes Rendus*, **199.** *pp.* 731–734, *Oct.* 15, 1934.—From the author's equation for birefringence, $b^2 = (\cos^2 V \sin^2 \alpha - \sin^2 V \sin^2 \gamma) + \sin^2 2V \cos^2 \beta$, where b is the ratio of the birefringence in the given direction to $n_\gamma - n_\alpha$, α, β, γ the angles this direction makes with the axes of the indicatrix, and 2V the optic axial angle, by plotting the " surface of birefringence," *i.e.*, the locus of b as α, β, γ vary, it is shown that Bertin's surface of equal retardation is deducible by inversion, and hence also Raveau's results [see Abstract 1146 (1913)]. It is further shown that a plate cut parallel to the optic axes will, if $2V = 90°$, exhibit constant retardation in parallel light incident thereon at any angle. Of this diaspore ($2V = 84°$) gives a good approximate example. [See Abstract 3001 (1928).] C. A. S.

4827. Elastic Constants of Single Crystals of Iron. R. Kimura and K. Ohno. *Tôhoku Univ. Sci. Reports,* 23. *pp.* 359–364, *Aug.,* 1934. *In English. Report No.* 324 *of the Research Inst. for Iron, Steel and other Metals.*—From Young's modulus of elasticity E and the modulus of torsion *n* in various directions, the Voigt moduli were found for monocrystal iron at room-temperature. The results are as follows: $S_{11} \cdot 10^{12} = 0 \cdot 765$, $S_{12} \cdot 10^{12} = -0 \cdot 289$, $S_{44} \cdot 10^{12} = 0 \cdot 895$; $E_{[111]} : E_{[100]} = 2 \cdot 06$, $n_{[111]} : n_{[100]} = 1/1 \cdot 90$. These values are all given in C.G.S. units. AUTHORS.

4828. History of Load of Deformed Crystals. W. F. Berg. *Zeits. f. Krist.* 89. 3–4. *pp.* 286–294, *Oct.,* 1934. *In English.*—An X-ray method of examining the character of the deformations of a given crystal is described. On the assumption that the state of stress is constant over the whole crystal several relationships between the different slip planes and directions in rock-salt are given. These make it possible to say whether the stress really had been the same over the whole crystal and whether it had changed during the "life" of the crystal. J. T.

4829. Production of Large Single Crystals of Ice. J. M. Adams and W. Lewis. *Rev. Sci. Instruments,* 5. *pp.* 400–402, *Nov.,* 1934.—A convenient method for locating the crystalline axes in ice, and therefore for determining the extent of any single crystal of ice in a block, has been developed. Single crystals of ice, satisfying this test, of dimensions limited only by the size of the apparatus, have been prepared. AUTHORS.

4830. Suggested Form of Crystallographic Presentation. M. A. Peacock. *Am. J. Sci.* 28. *pp.* 241–254, *Oct.,* 1934.—The scheme proposed is tentative only. The essentials for two-circle work (polar elements and coordinate angles) are brought into conjunction with the needs of the single-circle worker. It is considered an improvement over the usual lists of interfacial angles. F. I. G. R.

4831. Etched Quartz Crystals for X-Ray Spectrometers. L. G. Parratt. *Rev. Sci. Instruments,* 5. *pp.* 395–400, *Nov.,* 1934.—With a vacuum two-crystal spectrometer the (1, − 1) curves of etched quartz, etched calcite and relatively poor calcite cleavage surfaces have been studied throughout the wave-length range 0·5 to 5 Å. The widths of the curves at half maximum intensity, the percent reflection, and the coefficient of reflection have been measured. The shapes of the (1, − 1) curves vary with wave-length but vary oppositely with quartz and with calcite. The study is primarily concerned with the possibilities of etched quartz as spectrometer crystals. The resolving power of X-ray spectrometers can be increased by a factor of 2 to 4 by using quartz instead of calcite but the diminution of intensity necessarily associated with such an increase in resolving power may be impractical except for studying relatively strong characteristic radiation. AUTHOR.

4832. Two-Crystal Moving-Film Spectrometer for X-Ray Crystal Analysis. J. M. Robertson. *Phil. Mag.* 18. *pp.* 729–745, *Nov.,* 1934.—A two-crystal moving-film spectrometer for general use in photographic X-ray crystal analysis is described. The two crystals are alternately exposed to the X-ray beam throughout the whole time of the experiment, thereby averaging out any fluctuations in the output of the X-ray tube, and the reflections are sorted out and placed side by side on a moving film of the roller type by means of automatic shutters. In general the apparatus can be used to record the reflections from any two crystal specimens on one film in one operation. The two sets of reflections thus get identical subsequent treatment as regards development, etc., and accurate comparisons are possible. There are a wide variety of uses for the instrument, such as placing the reflections from an unknown crystal on an absolute scale by comparison with those of an accurately known standard, recording the effect on the intensities of heating or cooling one specimen, etc. The fact that a whole zone of reflections from each crystal can be recorded in one operation makes the present method important when any really detailed analysis is in view. When used with a single crystal in ordinary work, the automatic shutters can be employed to reduce the strong reflections by a given factor, and so render their comparison with the weaker reflections more accurate. Tables of constants and correction factors have been computed, and a chart prepared, to aid the interpretation of the films. Examples of results obtained are given. AUTHOR.

4833. Photographic Determination of Intensities of X-Ray Reflections from Powders. G. W. Brindley and F. W. Spiers. *Phys. Soc., Proc.* 46. *pp.* 841–852, *Nov.* 1, 1934.—A simple and accurate method of measuring the intensities of X-ray reflections from powders is described. The method consists in reflecting X-rays from a plane, stationary layer of powder. Its special advantages are that the absorption factor can be accurately obtained by its means, and the variation of focussing across the film can be utilised to give lines of approximately the same blackness for reflections of widely different intensities. Three examples are given illustrating the use of the method for comparing reflections from mixed powders, for comparing widely different intensities, and for measuring intensities at large angles of reflection. AUTHORS.

See also Abstracts 4799, 4840, 4841, 4891, 4964, 5013, 5065, 5112, 5136, 5137, 5192, 5198, 5232, 5233, 5236, 5237, 5238, 5243.

DENSITY.

4834. Vapour Density of Sulphur Dioxide. W. W. Stewart and O. Maass. *Canad. J. of Research,* 11. *pp.* 530–538, *Oct.,* 1934.—The technique developed in this laboratory for measuring gas densities has been made still more sensitive by using a 50-litre volume. The experimental results obtained showed that the apparent molecular weight-pressure isothermal for sulphur dioxide is not a straight line. This is in agreement with the equation of state for gases at low pressures, the study of which has been the main object of this investigation. From the data on sulphur dioxide its true molecular weight was found to be 64·075. [See Abstract 4435 (1932).] AUTHORS.

DIFFUSION AND OSMOSIS.

4835. Diffusion of Vapours through Gas Films. T. K. Sherwood and E. R. Gilliland. *Indust. & Engin. Chem.* 26. *pp.* 1093–1096, *Oct.,* 1934.—The process of diffusion from a solid or liquid into a gas is briefly discussed. It is considered to consist of a combination of molecular diffusion in the laminar layer near the surface, and eddy diffusion in the more distant turbulent region. Results of recent experiments on the rate of vaporisation of several liquids into air [see Abstract 2729 (1934)] are reviewed, and methods, with examples, given for predicting the diffusion rate of a vapour from a knowledge of that of another vapour, experimental conditions being the same. In connection with the design of absorption towers it is considered that the capacity coefficient, *i.e.*, the weight diffusing per unit time per unit volume of packing per unit driving force expressed as pressure difference, is a more reliable means of reporting the performance of a tower than is that given in terms of the height of packing equivalent to one theoretical plate (H.E.T.P.). R. W. P.

See also Abstracts 4794, 4861.

ELASTICITY AND PLASTICITY.

4836. Torsion of Beams of ⊥- and L- Cross-Sections. B. R. Seth. *Cambridge Phil. Soc., Proc.* 30. *pp.* 392–403, *Oct.* 30, 1934.—The problem of the torsion of beams of ⊥- and L- cross-sections is here solved by a method of conformal representation due to Trefftz. A. J. McC.

4837. Determination of Poisson's Ratio by Ultrasonic Vibrations. R. Bär and A. Walti. *Helv. Phys. Acta,* 7. 7. *pp.* 658–661, 1934. *In German.*—By comparing the wave-lengths of longitudinal and torsional stationary waves in a solid it is possible to deduce Poisson's ratio. The longitudinal waves are excited alone by disposing the solid with its surface normal to the incident wave ; the torsional wave by arranging that the angle of incidence is greater than the angle of total reflection for longitudinal waves. The results of experiments with a glass wedge are given. J. E. R. C.

4838. Electrically-Maintained Vibrating Reed for Determination of Young's Modulus. R. M. Davies and E. G. James. *Phil. Mag.* 18. *pp.* 1023–1052, *Nov.*, 1934. *Supplement.*—The problem considered is that of a reed rigidly fixed at the bottom and having a rectangular strip of stalloy attached at the top. This is caused to vibrate by the combined action of two coils wound on a soft iron core, one carrying d.c. and the other a.c. A theoretical investigation is made to find how the amplitude and velocity of the reed and the so-called "motional" resistance and impedance of the a.c. coil vary with the coil's pulsatance ω, when the reed's amplitude is small and hysteresis and eddy currents in the iron core are neglected. The free pulsatance ω_0 of the reed gives its Young's modulus and it is found that the maximum values of the above-mentioned quantities occur at pulsatance ω_1 which is less than ω_0. When the reed's amplitude becomes finite, the curves are distorted and the maximum pulsatance is a function of ω_1 and the amplitude. Later the effects due to hysteresis and eddy currents in the core are considered for small amplitudes and are found to alter the results considerably. H. M. B.

4839. Plastometric Investigations of Highly Consistent Substances. Part I. Construction of a Plastometer. G. Ungar. *Kolloid Zeits.* 69. *pp.* 30–35, *Oct.*, 1934.—In the instrument now described laminar shearing takes place between hemispherical surfaces. With liquids whose viscosities range between 100 and 10,000 poises, the separate points of the force-velocity curve are accurately determined within an error of less than 0·5%, whereas the error by the determination of absolute viscosity coefficients may attain 2 %. The measuring range of the apparatus is from 10 to 10^8 poises. H. H. Ho.

4840. Crystallite Orientation in a Polycrystalline Metal during Plastic Flow. R. E. Gibbs and N. Ramlal. *Phil. Mag.* 18. *pp.* 949–956, *Nov.*, 1934. *Supplement.*—In confirmation of the results of Andrade and Chalmers [see Abstract 720 (1933)], X-ray measurements show that, when a polycrystalline metal flows, that part of the flow, called the β flow, which gradually diminishes with time is connected with a rotation of the axes of the crystallites. AUTHORS.

4841. Plasticity of Cast and Recrystallised Metals. U. Dehlinger and F. Gisen. *Phys. Zeits.* 35. *pp.* 862–864, *Nov.* 1, 1934.—Previous work on the plasticity of Al single crystals [see Abstract 35 (1934)] is extended. The effects of impurity, and the differences between cast and recrystallised metals are considered. From the results obtained it is concluded that for an ideal lattice of a metal of high symmetry the critical shear stress is infinitely small, but that any disturbance due to such causes as the introduction of foreign atoms or the occurrence of mosaic structure is accompanied by an increase in hardness. J. T.

4842. Oscillations of a Stiff Cable with a Heavy Bob. W. Meyer zur Capellen. *Ann. d. Physik,* 20. 7. *pp.* 689–702, *Sept.,* 1934.—As a strict analysis of the oscillations of a stiff cable (one with definite elasticity moduli) having a very heavy bob, is very lengthy, an approximate formula for the natural frequency is given. Conditions of equilibrium are investigated. In certain cases, the problem reduces to that of a vibrating rod, either freely suspended [see Abstract 61 (1933)] or made to oscillate about a horizontal or a vertical axis. Formulæ for the characteristic frequencies of forced vibrations are obtained, and the position of resonance discussed only in the case of true cables. H. M. B.

4843. Breaking Strength of Glass. A. J. Holland and W. E. S. Turner. *Soc. Glass Technol., J.* 18. *pp.* 225–251, *Sept.,* 1934.—Determinations of the modulus of rupture have been made on 2300 specimens cut with a diamond under constant load, from 26-oz. drawn sheet glass of composition: SiO_2 72·22, $Al_2O_3 + Fe_2O_3$ 1·92, CaO 8·84, MgO 2·89, Na_2O 13·96 %. For specimens tested 3 days after re-annealing, with the diamond-cut edge in tension, the modulus of rupture varied from 613 kg./cm.^{2}, for a width 0·6 cm. to 486 for width 1·5 cm. Specimens with mechanically ground and polished edges had a modulus of 572 kg./cm.^{2}, for widths 0·89–0·93 cm. Three types of fracture, straight, V, and $\frac{1}{2}$-V shape, were found, dependent on width and on edge condition. Straight fractures were regularly obtained with specimens less than 0·9 cm. wide, with cut edges or ground and polished edges. Specimens with fire-finished edges always gave a large proportion of V and $\frac{1}{2}$-V fractures whatever the width tested. AUTHORS.

4844. Influence of Temperature on the Bursting Pressure of Bottles. B. Longmuir and W. E. S. Turner. *Soc. Glass Technol., J.* 18. *pp.* 252–259, *Sept.,* 1934.—Determinations of the bursting pressure of bottles of a type used for containing pasteurised beer have been made under carefully controlled conditions, using water as pressure medium at 15°, 25°, 40°, 50°, 60°, 75°, and 95°, and oil at 25°, 40°, 60°, 75°, 95°, and 150°. The bursting pressure was found progressively to diminish with rise of temperature in such form that over the temperature range investigated the product of absolute temperature and bursting pressure was approximately constant. AUTHORS.

4845. Effect of Rate of Loading and Torsional Deformation on the Breaking Strength of Glass Rods. G. Apelt. *Zeits. f. Physik,* 91. 5–6. *pp.* 336–343, *Oct.* 5, 1934.—Rods of Thüringen apparatus glass are subjected to extensional stress and the breaking strength (breaking load per unit cross sectional area of rod) at room-temperature is found to increase as the rate of loading is increased. At the same time it is observed that the plane " mirror " portion of the break decreases in area, so that the so-called true breaking strength (defined as breaking load per unit area of the non-mirror part of the cross-section) remains practically constant. No such effects are found at liquid air temperature. Also no change of breaking strength is caused by previous plastic deformation (torsion) of the rods at a temperature just under the transformation point of the glass. L. A. W.

4846. Breaking Strength of Plastically Deformed Glass Rods. G. Thierbach. *Zeits. f. Physik*, 91. 5–6. *pp.* 344–348, *Oct.* 5, 1934.—Torsional plastic deformation of rods of lead glass at temperatures below the transformation point is found to cause no definite change in their breaking strength at room-temperature for extensional stress. An appreciable diminution of the mean area of the plane " mirror " portion of the break is, however, observed. [See preceding Abstract.] L. A. W.

4847. Graphic Computation of the Strength of Windows. A. F. Dufton. *Phil. Mag.* 18. *pp.* 792–795, *Nov.*, 1934.—A simple nomogram is discussed for determining safe glazing sizes of windows and for computing the uniform pressure a rectangular pane will bear. J. S. G. T.

4848. Electric Manometer for Pressures up to 3000 Atmospheres. A. Michels and M. Lenssen. *Journ. Sci. Instruments*, 11. *pp.* 345–347, *Nov.*, 1934.—The construction of a differential electric manometer depending upon the variation of resistance of manganin coils with pressure is described. A special form of plug resistance is employed in the bridge circuit, whereby the number of plugs in use is always the same, thus decreasing variation due to contact resistance.

AUTHORS.

4849. Magnetic Brake for Applying an Even Tension to a Moving Thread. G. R. Stanbury and E. E. Marshall. *Journ. Sci. Instruments*, 11. *pp.* 348–357, *Nov.*, 1934.—The importance of applying a known even tension to a moving thread for textile testing is stressed, and the methods at present in use are reviewed. An instrument complying with the necessary conditions is described, its two main functions being applying and levelling tension. The former is carried out by the braking of a metal disc in a magnetic field by means of eddy currents, the mechanical dimensions being so chosen that the braking is directly proportional to the applied current in the electromagnet ; the latter is so arranged that small variations in the tension of the yarn from the bobbin alter the emission current from a photocell, which, when amplified through a gas-filled relay circuit, operates a subsidiary electromagnetic brake. The theory of the brake is outlined and methods of calibration are described. Typical records of its performance are given. AUTHORS.

4850. Measurement of Pressure Exerted by a Material, Maintained at Constant Length, When It Absorbs Moisture. N. Davey. *Journ. Sci. Instruments*, 11. *pp.* 362–364, *Nov.*, 1934.—A description is given of an apparatus designed to measure the pressure exerted by a specimen of material, held at constant length, while it absorbs moisture. The observed pressures are found to be considerably lower than the theoretical values estimated, without allowing for the effects of creep, from a knowledge of the moisture movement in an unrestrained condition, and the modulus of elasticity. AUTHORS.

4851. Heterogeneity of a Solid Solution and its Mechanical and Chemical Properties. P. Chevenard. *Comptes Rendus*, 199. *pp.* 861–863, *Oct.* 29, 1934.—A short account is given of investigations upon an alloy (iron with 37 % Ni, 10 % Cr and 0·3 % C.) which reveal a marked parallelism between the heterogeneity, as measured by the author's thermomagnetic method [see Abstract 2195 (1934)], and the mechanical and chemical properties. The mechanical properties investigated include hardness, elastic limit, internal friction, etc., and the chemical property chosen is resistance to corrosion. L. A. W.

See also Abstracts 4802, 4864, 4944, 4945, 5148, 5192, 5257.

GRAVITATION.

4852. Fundamental Tables for the Reduction of Gravity. Part I. G. Cassinis and P. Dore. *Com. Geod. e Geofis., Boll.* 4. *pp.* 1–19, *July,* 1934.—After considering the criteria which lead to the construction of the tables and numerical constants, necessary to them, an explanation is given of the calculation made, following Hayward's methods, to obtain the tables on the hypothesis of a spherical earth of radius $R = 6371\cdot 2$ km. H. M. B.

4853. Valuation of the Effect of the Ellipsoidal Configuration of the Earth in the Reduction of Gravity. S. Ballarin. *Com. Geod. e Geofis., Boll.* 4. *pp.* 20–41, *July,* 1934.—The correction to be added to the value of the reduction of gravity, obtained by considering the earth as spherical, is calculated to account for its ellipsoidal shape. Higher powers than the fourth of the numerical value of the eccentricity of the ellipse are neglected. The limits of altitude of the zone are taken between + 10 km. and − 125 km. H. M. B.

4854. Reduction of Gravity Observations to Sea-Level for the Purpose of Determining the Geoid. W. D. Lambert. *Bull. géodésique, No.* 41. *pp.* 26–33, *Jan.-Feb.-March,* 1934. *In English.*—Two unrealised assumptions are made in Stokes' method for determining the form of the geoid by means of gravity anomalies, (1) the geoid envelops all attracting matter, (2) all observations of gravity represent values of gravity as they would be on a geoid fulfilling assumption (1). Observations at sea on a submarine produce no serious difficulty when reduced to sea surface. Observations on land are mostly near to the surface and reduction of them to sea level to overcome assumptions (1) and (2) presents a problem of some difficulty. The difficulty with projecting land masses arises from unknown irregularities in distribution of density. The advantages of the free air and isostatic methods of reduction are discussed and reasons are given for preferring the latter. R. S. R.

HYDRODYNAMICS AND AERODYNAMICS.

4855. Theory of Laminar Non-Turbulent Flow in the Neighbourhood of a Biplane. G. Schmitz. *Ann. d. Physik,* 21. 1. *pp.* 37–66, *Oct.,* 1934.—The characteristics of laminar non-turbulent flow in the neighbourhood of a biplane structure is investigated mathematically. The circulation is determined by Joukowsky's method. The distribution of pressure is calculated arithmetically as an example of the application of the results obtained. J. S. G. T.

4856. Turbulent Wake Behind a Body of Revolution. C. C. Wang. *Tsing Hua Univ., Sci. Reports,* 2. *pp.* 307–326, *Aug.,* 1934. *In English.*—Kármán's form of the "mixing length" and apparent stress for turbulent fluid motion according to his law of dynamical similarity is verified to hold for three dimensional motion with rotational symmetry. The velocity distribution within the wake behind a body of revolution is calculated according to the above theory and the result, expressed in terms of Bessel functions, has been put into a form convenient for comparison with experiment. It is shown that the force of resistance acting upon a moving body can be computed from the measurement of the velocity distribution. AUTHOR.

4857. Anomalous Turbulence of Sols. Wo. Ostwald. *Kolloid Zeits.* 68. *pp.* 211–226, *Aug.*, 1934.—Congo red and benzopurpurin sols containing salts are anomalous in that, although their viscosity is greater than that of water, they exhibit turbulent flow at lower velocities of flow than does water; cotton yellow and geranin exhibit the same anomaly, but to a less marked degree. The critical Reynolds number of 1 % solutions (water = 100) is of the order of 6–9 % in presence of up to 1·2 % of salt, as compared with 40–50 for salt-free sols. For 2 % gum-arabic sols the relative critical Reynolds number is 36, turbulent flow occurring at remarkably low velocities. Considerable extension of classical hydrodynamical theory is required in order to deal with the phenomena of flow in colloidal systems. H. F. G.

4858. Hydraulic Analogy Relating to the Motion of a Compressible Fluid. D. Riabouchinsky. *Comptes Rendus*, 199. *pp.* 632–634, *Oct.* 1, 1934.—An extension [see Abstract 468 (1933)] of the analogy between the two-dimensional motion of water in a channel and that of a gas in a tube, is generalised, and practical applications are suggested. J. S. G. T.

4859. Divergent Flow of Fluid. W. R. Dean. *Phil. Mag.* 18. *pp.* 759–777, *Nov.*, 1934.—The stability of the radial motion in divergent flow of fluid is discussed mathematically. J. S. G. T.

4860. Flow of Liquid over a Plate. Chien Ting Chwang. *Tsing Hua Univ., Sci. Reports*, 2. *pp.* 327–333, *Aug.*, 1934. *In English.*—Experimental data are presented in this paper showing how the rate of flow of linseed oil down a plate varies with the depth of the stream and the pressure gradient along the stream. The dependence of the pressure gradient on different factors is also shown. AUTHOR.

KINETIC THEORY OF MATTER.

4861. Derivation of Formulæ for Brownian Movement. Y. Muto. *Phys. Math. Soc., Japan, Proc.* 16. *pp.* 357–361, *Oct.*, 1934. *In English.*—This entirely mathematical paper gives novel modes of derivation for formulæ concerned with the Brownian movement, diffusion, and Brownian movement in a uniform field of force. H. H. Ho.

4862. Distribution Functions in Brownian Motion. L. S. Ornstein and W. R. van Wijk. *Physica*, 1. *p.* 966, *Oct.–Nov.*, 1934. *In English.*—Corrections. [See Abstract 1848 (1934).]

See also Abstracts 5028, 5029.

LENGTH (STANDARDS, MEASUREMENTS, APPARATUS).

4863. International Prototype Metre. O. C. Hilgenberg. *Gerlands Beitr. z. Geophys.* 42. 4. *pp.* 409–412, 1934.—The results of five wave-length determinations of the international prototype metre during the past

40 years are compared. By excluding one result the conclusion is reached that the prototype is increasing in length by 1 part in 10^7 every 10 years. It is suggested that this effect is related to the average rate of increase of the earth's diameter during a period of 500 million years, as calculated from geophysical evidence. H. B.

MATHEMATICAL METHODS, THEORY OF MEASUREMENTS. UNITS AND DIMENSIONS.

4864. Analysis of Oscillation Curves. F. Vercelli. *Ricerca Scientifica,* 1. 7. 1934. *Com. Geod. e Geofis., Publ. No.* 4. [22 *pp.*], 1934.—The author describes a simple arithmetical process suitable for analysing all types of oscillation curves likely to be met with in research. The exposition is elementary and will serve as a guide in recognising periodicity, in the interpretation of graphs, and in the prediction of phenomena. W. A. R.

4865. Peculiar Traditional Error Relating to the Theory of the Infinite Screw. M. d' Ocagne. *Comptes Rendus,* 199. *pp.* 649–650, *Oct.* 8, 1934.—For transmission of rotation at constant speed between two rectangular axes, X and X_1, not coinciding, a classical arrangement is made up from an infinite screw which can be reduced to this with one development of a circle, C, containing and perpendicular to X and the other a section of a screw surface at X_1, for which at each instant a geneatrix C_1, is in contact with C at a point tangential to the first circle and parallel to X_1. In all mechanical theory a helicoidal development is given for the surface but it is shown that this does not give a simple point of contact. The necessary condition is not a helicoidal development of the base C but a surface inscribed in this helix. The point is of theoretical rather than practical importance. R. S. R.

4866. Solution of Algebraic Equations by Tables of Logarithms. V. A. Bailey. *Phil. Mag.* 18. *pp.* 529–539, *Oct.,* 1934.—The methods of Newton and Horner involve computations equivalent to the evaluation of terms like px^m (m an integer) where p and x may both contain several digits. The latter evaluation is most conveniently carried out by means of logarithm tables, and a method is described for approximating to the real roots with the help of such tables. Examples of the application of the method are given. G. E. A.

4867. Units. A. Iliovici. *Soç. Franç. Élect., Bull.* 4. *pp.* 970–992, *Oct.,* 1934.—The author deals with the principal questions discussed at previous Sessions and presents what may be regarded as a majority Report, supplemented by references to divergent opinions on specific points. The detailed discussion of the principal questions is under the headings: Physical Relations; Nature of Coefficients in Physical Relations; Dimensions; Use of Dimensional Equations; Dimensions of Unit Angle; System of Units and Number of Fundamental Units; Electrostatic and Electromagnetic Units; and Need for Distinct Names for Units of Field and Induction in the Electromagnetic System. By writing the dimensional equations for each unit before fixing the value of any other unit, a single system of units, based on four fundamental units, is obtained for the measurement of electromagnetic quantities. With length, time, mass and quantity of electricity as the fundamental units, a single dimensional equation is obtained for each unit. On the treatment developed, the units H, B of field and induction have different dimensions and should have different names. R. E. N.

4868. Instrument Dials. W. G. Collins. *Journ. Sci. Instruments,* 11. *pp.* 341–345, *Nov.,* 1934.—This paper gives some technical details of commercial methods of printing dials for many kinds of industrial instruments. Reference is also made to dials of the type usually applied to pivoted instruments, in which higher accuracy is required than in industrial instruments, and to precision dials which require a special dividing engine for their production. J. S. C.

See also Abstracts 4847, 4879, 5235.

MECHANICS, CLASSICAL.

4869. Gyroscopic Pendulums. J. G. Gray. *Roy. Soc. Arts, J.* 82. *pp.* 1140–1156, *Oct.* 5; 1161–1175, *Oct.* 12; 1189–1210, *Oct.* 19, and *pp.* 1215–1236, *Oct.* 26, 1934.—Discusses general theory, with numerous experimental models; gyrostatic action of flywheels, turbines, aeroplane propellers, etc.; gyroscopic pendulum; stable gyroscope on bifilar suspension; Blondin tops; gyroscopes on stilts, on gimbals, on double unstable gimbals without spin; simplified form of equations; mono-rail top; behaviour of gyroscopic devices on moving vehicles; determination of coefficients for equations applicable to gyroscopic appliances; monorail car running on a circular track in the direction of, and opposite to, that of the spin of the gyroscope; inverted mono-rail gyroscope; rotation; doubly unstable gyroscope; pendulum and neutral gyroscopes on rotating gimbals; gyroscopic pendulum under action of rotating couple; gyroscopic erectors; equations of motion and problem in rotatory motion. A. D.

See also Abstracts 4865, 4886, 4944, 4945.

MECHANICS, QUANTUM.

4870. Combined Perturbation Methods in the Many-Electron Problem. H. Hellman. *Comptes Rendus de l'Acad. des Sciences, U.R.S.S.* 3. *pp.* 444–446, *Aug.* 21, 1934. *In German.*—It is shown how the Schrödinger variation method in the many-electron problem can be combined with the Thomas-Fermi variation principle. G. C. McV.

4871. Production of Pairs by Collisions of Heavy Particles. W. Heitler and L. Nordheim. *J. de Physique et le Radium,* 5. *pp.* 449–454, *Sept.,* 1934.—A method is developed for calculating the production of pairs by the collisions of particles. Relativistic interaction is studied; it is shown that this interaction may be taken into consideration to the same degree of approximation as that which is used in dealing with the problems of radiation in general. The results are exemplified by discussing collisions of heavy particles. H. L. B.

4872. Quantisation of the Scalar Relativistic Wave Equation. W. Pauli and V. Weisskopf. *Helv. Phys. Acta,* 7. 7. *pp.* 709–731, 1934. *In German.*—The Heisenberg-Pauli quantisation of wave fields is applied to the scalar relativistic wave equation for systems of particles obeying the Einstein-Bose statistics. The existence of particles of equal mass but opposite charge, which can be created and destroyed with the absorption or emission of electromagnetic radiation, is shown to follow without additional hypotheses, and the probabilities of such processes are shown to be of the same order as for the electrons and positrons in Dirac's theory of "holes." Compared with Dirac's theory the present theory has the advantage that the energy is essentially positive although the difficulties of infinite self-energy and infinite polarisability of a vacuum remain. Particle spin plays no part in the theory (Bose-Einstein statistics).

W. S. S.

4873. Ellipsoidal Wave Functions. S. L. Malurkar. *Indian Journ. Phys.* 9. *pp.* 45–80, *Sept.*, 1934.—Normal functions are obtained and investigated suitable for boundary conditions over ellipsoids or other central quadrics for the wave equation $\Delta\phi - \frac{1}{C^2} \cdot \frac{\partial^2\phi}{\partial t^2} = 0$. The differential equation is derived in algebraic form, and boundary conditions being specified, the form involving Jacobean elliptic functions is $\frac{d^2U}{d\xi^2} + (a_0 - a_1 k^2 sn^2 \xi - n^2 k^4 sn^4 \xi)U = 0$, where n is a constant and a_0 and a_2 are characteristic constants. The solutions can be written in the form $(sn\,\xi)^{\sigma_1} (cn\,\xi)^{\sigma_2} (dn\,\xi)^{\sigma_3} \psi (sn^2\,\xi)$, where ψ is an integral function of $sn\,\xi$ and $\sigma_1, \sigma_2, \sigma_3$ have values of 0 or 1. The characteristic constants are real in dealing with real Cartesian space. The non-linear integral equations of the characteristic functions are deduced, and the actual form of the nuclei for the four species and eight types is given. The integral equation can be solved for small values of n by ordinary methods, and the method of stationary phase gives the asymptotic expressions for large values of $sn\,\xi$. N. M. B.

4874. Waves, Spin, and Integers. E. Sevin. *Comptes Rendus*, 199. *pp.* 702–704, *Oct.* 15, 1934.—An exact expression is found for M_0 the composite mass (of velocity V, radius vector R, and the relation $V/c = B$) whose effect is equivalent to the simultaneous action of an electron and proton, analogously specified, which acquire equal quantities of motion around their centre of gravity. This expression completes the approximate formula given by wave mechanics. Considerations of fundamental orbits show that the structure period T, related to the wave-length c/v, seems to be propagated with the velocity c^2/V. It is shown that the inverse of the fine-structure constant, must be an integer, 137. The defined fundamental orbits are shown to be compatible with a spin of period 3T. The number of impacts of the particle with the structure wave, the trajectories, and the period of revolution can all be expressed in relations containing as a coefficient the first or second powers of the constant 137. N. M. B.

4875. Axioms of de Broglie's Theory of Photons and Superquantisation. J. L. Destouches. *Comptes Rendus*, 199. *pp.* 779–781, *Oct.* 22, 1934.—Seven postulates concerning photons, operators, and quantisation are defined relative to de Broglie's theory [see Abstract 4175 (1934)], and are shown to conform with the general system of wave mechanics. Dirac's theory of radiation is shown to appear as a first approximation in the new theory of photons. N. M. B.

4876. Interchange Problems and Second Quantisation. P. Jordan. *Zeits. f. Physik*, 91. 3–4. *pp.* 284–288, *Oct.* 2, 1934.—It is shown that problems in wave mechanics involving a number of electrons can be simply treated by the method of quantised waves. J. S. G. T.

4877. Quantum Theory and Wave Mechanics. G. Wentzel. *Die Physik*, 2. 4. *pp.* 141–152, 1934.—The following subjects are briefly reviewed (1) non-relativistic quantum theory, (2) Dirac's electron theory,

(3) quantum electrodynamics, (4) Born's field theory and de Broglie's hypothesis of the relationship between light quanta and the neutrino.
J. S. G. T.

4878. Rotational Wave Equation of Tetramethylmethane for Zero Potential and a Generalisation. L. J. B. LaCoste. *Phys. Rev.* 46. *pp.* 718–724, *Oct.* 15, 1934.—An exact solution for the rotational wave equation of tetramethylmethane for constant potential has been found. The solution is very similar to that of the rigid spherical top, which is the other limiting case for the rotational motion of the molecule in question. The energy levels for free rotation of the methyl groups are spread out compared to those for fixed methyl groups. This might make possible an estimation of the potential function between the groups. The energy levels might be used to calculate the specific heat. Some selection rules are given for infra-red and Raman spectra although the rotational spectra are just beyond the limit of resolution at present. A generalisation has been made for a spherical top with attached gyroscopes whose axes are rigidly fixed on the top according to certain symmetry requirements.
AUTHOR.

4879. Approximate Wave Functions and Atomic Field for Mercury. D. R. Hartree. *Phys. Rev.* 46. *pp.* 738–743, *Oct.* 15, 1934.—Approximate wave functions and atomic field for mercury have been calculated by the method of the self-consistent field, and tables of preliminary results are given. A considerable part of the calculation was carried out on the differential analyser, and a short account of its application to this work is given.
AUTHOR.

4880. Wave-Mechanical Treatment of the Li_2 Molecule. H. M. James. *J. Chem. Phys.* 2. *pp.* 794–810, *Nov.*, 1934.—A treatment of the Li_2 molecule by the Heitler-London method, with Slater wave functions for the atoms, has been carried out both with and without the customary approximations. In the absence of these approximations the binding computed is only a small fraction of that observed. It is found that the inner shells of the atoms may have an important effect on the magnitude of molecular binding, and may either increase or decrease it. Since their effect is associated with electron exchange it appears that they cannot be replaced by an equivalent potential field without serious error. Triple exchanges of electrons are found to be important, while polar binding is quite negligible in Li_2. A criterion for the applicability of the " interaction operator " is developed; the error involved in its use with Li_2 is small. A variational treatment has also been applied to this molecule. It yielded a binding energy less than that observed by about 0·5 e.V. The elimination of the residual error apparently requires the introduction of the interelectronic distances as coordinates. Convenient methods for the numerical treatment of multiple electron exchanges in complicated molecules are described.
AUTHOR.

4881. Approximations Involved in Calculations of Atomic Interaction and Activation Energies. A. S. Coolidge and H. M. James. *J. Chem. Phys.* 2. *pp.* 811–817, *Nov.*, 1934.—The assumptions underlying the computation of interaction energy among several atoms, and especially of activation energies, have been analysed and discussed for the case of small overlapping of the one-electron wave functions involved. Some formal justification has been found for several types of approximation which have hitherto been used without adequate examination. Computations of the energy of several three-electron systems are presented as material illustrating the applicability of some of the assumptions to typical cases. It is concluded that in general any modifications of the complete Heitler-London treatment of the system may lead to errors comparable in magnitude to the quantity to be computed. The so-called "semi-empirical method," which involves many such modifications, owes its success to a happy cancellation of errors, and, until some theoretical explanation of this cancellation is found, it must assume the status and responsibilities of a purely empirical method. AUTHORS.

4882. Indeterminacy Relation for Several Observables and its Classical Interpretation. H. P. Robertson. *Phys. Rev.* 46. *pp.* 794–801, *Nov.* 1, 1934.—An examination of the limitations placed by the conceptual structure of quantum mechanics on the simultaneous measurement of two or more observables leads, for the case of an even number $m = 2k$ of observables, to a quantitative estimate, depending only on the mean values of their commutators in the state in question, of the least value which the product of their m uncertainties may assume. This indeterminacy relation is interpreted classically to mean that, by measurement of these observables alone, a point (p, q) in phase space can be determined only to within a certain channel whose normal cross section, as measured by the value of the kth integral invariant taken over it, must be at least of order h^k. AUTHOR.

See also Abstracts 4782, 4791, 4850, 5081, 5098, 5099, 5104, 5132, 5138, 5139, 5140, 5143, 5192, 5226, 5228, 5230.

RELATIVITY AND ETHER.

4883. Physical Interpretation of Relativity Equations. J. Mackaye. *Frank. Inst. J.* 218. *pp.* 343–380, *Sept.*, 1934.—The paper is unsuitable for abstraction. Original should be consulted.

4884. Application of Clifford Numbers to the Proof of the Lorentz Relativity Formula. A. Mercier. *Helv. Phys. Acta*, 7. 7. *pp.* 649–650, 1934. *In French.*—It is shown how Clifford numbers can be used to establish the formulæ for the Lorentz transformation of electromagnetic vectors. G. C. McV.

4885. Does the Rotating Disc Example Imply Non-Euclidean Geometry ? W. Glaser. *Phys. Zeits.* 35. *pp.* 867–870, *Nov.* 1, 1934.—The author establishes that the differentials $r d\theta$ and dt in $ds^2 = dt^2 - dr^2 - r^2 d\theta^2$ undergo a transformation similar in form to the Lorentz transformation when new axes, rotating with constant angular velocity about the same origin, are introduced. He claims that this solves the difficulty of the rotating disc example in relativity without recourse to non-Euclidean geometry. G. C. McV.

See also Abstracts 4877, 4970, 5194, 5228, 5240.

SOLUTION.

4886. Theory of Strong Electrolyte Solutions. J. G. Kirkwood. *J. Chem. Phys.* 2. *pp.* 767–781, *Nov.*, 1934.—The nature of the approximations involved in the derivation of the Poisson-Boltzmann equation of the Debye-Hückel theory is investigated in detail from the standpoint of classical statistical mechanics. The validity of the initial Debye approximation, under the restrictions originally imposed upon it, is confirmed. Deviations arising from fluctuation terms and van der Waals forces are roughly estimated. An alternative to the Bjerrum method for the treatment of ions of small size and high valence is outlined. AUTHOR.

4887. Two Theorems Concerning Electrolytes. R. M. Fuoss. *J. Chem. Phys.* **2.** *pp.* 818–821, *Nov.*, 1934.—(1) Fluctuations in the average total electrostatic energy $\bar{E}$ of the free ions of an electrolytic solution as calculated by the theory of Debye and Hückel are negligibly small in accessible concentration ranges. If $\delta E = \{\overline{E^2} - (\bar{E})^2\}^{\frac{1}{2}}$, then $\delta E/\bar{E} = (-kT/2\bar{E})^{\frac{1}{2}}$; *i.e.*, the ratio of the fluctuation in energy to the total energy is of the order of the square root of the ratio of the kinetic energy per degree of freedom of a *single molecule* to the *total* electrostatic energy of the system. (2) A general relationship connecting free energy F and average electrostatic energy $\bar{E}$ is derived; for the case where the average potential around an ion is given by the Debye-Hückel formula, $F = 2\bar{E}/3$. AUTHORS.

4888. Space Representation of the Saturation Relationships of Potassium Salts. E. Jänecke. *Zeits. f. Elektrochem.* **40.** *pp.* 735–743, *Nov.*, 1934.—In this lecture the methods of giving a complete representation of the saturation conditions of two or three salts present in a solution are considered, use being made of the data obtained by van't Hoff and his pupils in their investigations of the Stassfurt deposits. A number of diagrams are given. T. H. P.

4889. Critical Solution Temperatures of Hydrocarbons in Sulphur Dioxide. R. T. Leslie. *Bureau of Standards, J. of Research,* **13.** *pp.* 589–597, *Oct.*, 1934.—The variation with composition of the solution temperatures in sulphur dioxide of 17 paraffin and naphthene hydrocarbons of the naphtha fraction of petroleum has been determined. These data have been correlated with the boiling points of the hydrocarbons to determine the possibility of separating nearly constant-boiling mixtures of these hydrocarbons by extraction with sulphur dioxide. A few critical solution temperatures in aniline have been determined to complete a series for comparison with the data for sulphur dioxide. Some experiments on the behaviour of the hydrocarbons in ammonia were also made. It is also concluded that sulphur dioxide and ammonia offer little promise as extraction agents to supplement distillation. Aniline shows greater difference than ammonia or sulphur dioxide in its behaviour towards 3 classes of hydrocarbons, normal paraffin, iso-paraffin, and naphthene. AUTHOR.

4890. Solubilities of Krypton and Xenon in Liquid Oxygen. M. v. Stackelberg. *Zeits. f. phys. Chem.* **170.** *Abt.A.* 3–4. *pp.* 262–272, 1934.—The solubilities of solid Kr and Xe in liquid O_2 are determined between 70 and 90° Abs., the points of saturation being determined by vapour-pressure measurements. The observed solubilities are lower than those calculated from the heats of fusion of the inert gases assuming ideal behaviour of the systems. It follows that the heats of solution of the substances in liquid O_2 must be greater than their heats of fusion, so that heat is taken in when the liquid components are mixed. These heats of mixing are calculated from the experimental data. The vapour pressure measurements show that the partial pressure of the oxygen is greater than would correspond to Raoult's law. With the help of the heats of fusion and mixture the whole crystallisation curve and eutectic point are calculated for the system O_2-Kr. L. A. W.

See also Abstracts 4794, 5220.

SURFACE TENSION AND COHESION.

4891. Nature of the Metallic Bond. H. Bomke. *Zeits. f. Physik.* **91.** 5–6. *pp.* 400–409, *Oct.* 5, 1934.—From a consideration of the different properties of the metallic state it is concluded that the binding forces between the atoms of a solid or liquid metal are of a purely electrostatic nature. The cohesion of metal crystals is explained by electrostatic action between the lattice of positive ions and the cloud charge of metal electrons uniformly distributed over the lattice. It is also shown that with this distribution of electrons the lattice energy is a maximum. A relation is found between lattice energy and heat of vaporisation of the solid metal and the ionisation potential of the free atoms which agrees well with experimental values. Further, a simple formula is obtained for the exit-work of positive metal ions. [See also Abstract 392 (1934).]

G. E. A.

4892. Surface Tension of Glue and Gelatin Solutions. T. Ackermann. *Kolloid Zeits.* **69.** *pp.* 87–93, *Oct.*, **1934.**—The surface tensions were determined by the bubble method, the rate of bubble formation being controlled so as to enable the surface tensions of surfaces of varying ages to be determined. It was not possible to distinguish between solutions of hide-glue and bone-glue by these measurements. A high surface-tension temperature coefficient is associated with a high viscosity temperature coefficient. The surface tension of dilute gelatin solutions is a maximum at about pH 3·0. Thermolysis slightly reduces the surface tension of a gelatin solution, and acid hydrolysis increases it. Leucine and leucyle-glycine are capillary active and other peptides and aminoacids are capillary inactive. Casein, egg albumin and Witte's peptone are strongly capillary active. Froth reducing media depend for their action on the removal of the capillary active substances. Oil of cloves and milk raise the surface tension by desorption through emulsification.

P. H. B.

4893. Parachors of Alkyl Benzyl Ethers. Tzu-Ching Huang and Ken-Po Sung. *Tsing Hua Univ., Sci. Reports,* **2.** *pp.* 303–306, *Aug.,* **1934.** *In English.*—The parachors of seven alkyl benzyl ethers were determined by measurement of surface tensions by the method of capillary rise. The results agree satisfactorily with those obtained by adding up Sugden's constants.

AUTHORS.

4894. Experimental Test of the Validity of Antonow's Rule. E. G. Carter and D. C. Jones. *Faraday Soc., Trans.* **30.** *pp.* 1027–1038, *Nov.,* **1934.**—An experimental test of the validity of Antonow's rule has been made with a number of systems consisting of organic substances and water. Particular care has been taken with the following experimental points: (1) the organic substances have been carefully purified; (2) accurate methods for the determination of the three tensions concerned have been used; (3) the liquid phases have been maintained in a saturated condition. Confirmation of this relationship has been obtained with a number of such systems, but others do not conform with it. These latter can be divided into two groups. The first group contains systems where the organic substance has a negative initial spreading coefficient on water. The organic substances in the second group have high positive initial spreading coefficients on water, and it is the opinion of the authors that their nonconformity with this relationship may be due to an oriented adsorption film on the saturated aqueous phase.

AUTHORS.

4895. Structure of Monolayers of Myristic Acid. N. W. H. Addink. *J. Chem. Phys.* **2.** *p.* 822. *Nov.,* **1934.**—A correction [see Abstract 4070 (1934)].

4896. Drop-Weight as a Function of Rate of Drop Formation and Jet Diameter. A. Adler. *Phys. Zeits.* 35. *pp.* 864–867, *Nov.* 1, 1934.—Water, benzole, methyl alcohol, and ether, were allowed to drop from jets of 5·0 mm. to 15·9 mm. dia. and at rates ranging from about 0·5 to 8 sec. per drop. With the smaller jets the average weight per drop was found initially to increase with decreasing rate of formation, and then to fall asymptotically. A table based on the results obtained shows, for the four liquids employed, the maximum rate of drop formation which should be adopted with the particular jets used in the work.
P. H. B.

4897. Life-Period of Liquid Drops on the Surface of the Same Liquid. L. D. Mahajan. *Kolloid Zeits.* 69. *pp.* 16–21, *Oct.*, 1934.—It is found that oscillation of the liquid surface prolongs the life-period of the liquid drops on the surface of the same liquid. The greater the oscillation, the more stable are the liquid drops. A unilateral movement of the liquid surface raises the stability of the drops whose life period is extended with the magnitude of the surface velocity. Motion of the liquid drops upon the surface when at rest likewise increases their life-period, the secondary drops being stable for a longer period than the primary. The addition of a viscous liquid (up to a certain limit) to the mother liquid, increases the stability of the drops; above the limit, further addition renders drop formation impossible. The viscosity of the surrounding medium directly influences the life-period progressively, and absence of impurities increases the stability of the drops. When the vapour of the mother liquid is saturated, the drops are very stable. The viscosity of the surface of the mother liquid likewise exerts an influence up to a certain degree upon the life-period. H. H. Ho.

See also Abstracts 4808, 4809, 5233.

VISCOSITY, FRICTION AND LUBRICATION.

4898. Influence of Molecular Structure on the Variation of Viscosity between the Melting and Boiling Points. Mary D. Waller. *Phil. Mag.* 18. *pp.* 579–594, *Oct.*, 1934.—It is shown, by consideration of the viscosities of metals, halogens and organic substances, that the characteristic viscosity ratio, r, between values of the viscosity at the m.p. and b.p. is small (< 4) for liquids where molecules are either spherical or of high symmetry. For liquids having elongated molecules r is much higher. The value of r is very susceptible to change in molecular shape. In the case of benzene and its homologues the value of r ranges from 2·2 to 24. The r values for paraffins containing an odd number of C atoms in the molecule are higher than for those containing an even number. Evidence of the flexibility of the open hydrocarbon chain is provided by periodic variations in the value of r as the number of C atoms increases by 6 in both the paraffin and alcohol series. J. S. G. T.

4899. Viscosity and Fluidity of Lithium Chloride in Acetone Solution. G. R. Hood and L. P. Hohlfelder. *J. Phys. Chem.* 38. *pp.* 979–986, *Oct.*, 1934.—Measurements have been made on the viscosity of acetone solutions of lithium chloride at 18° C. over the range 0·004 to 0·274 mol./l., and at 25° C. over the range 0·0008 to 0·271 mol./l. The stiffening effect on the solution due to the electric forces of the ions in tending to maintain a space lattice structure has been observed. The value of the constant A obtained compares favourably with the theoretical value as calculated by Falkenhagen and Vernon. Fluidity-concentration curves are shown to be highly inflected. It is suggested that the complexity of the fluidity-concentration relationship expresses the resultant of three factors: interionic attraction—most effective at extreme dilution—and a solvation effect superimposed upon the effect which a solute itself exerts in decreasing the fluidity of the pure solvent. Evidence for solvation is adduced, and measures of the degree of solvation are obtained. AUTHORS.

4900. Viscometric Studies of Rubber Solutions. M. Reiner. *Physics,* 5. *pp.* 342–349, *Nov.,* 1934.—Support for the assumption that rubber particles in rubber-toluene solutions are solvated unordered aggregates is derived from a quantitative study of viscometric measurements, which shows that the forces acting between the primary particles (structural elements) must be very small. AUTHOR.

4901. External Friction at Mica Surfaces. B. Derjaguin and W. Lazarev. *Kolloid Zeits.* 69. *pp.* 11–16, *Oct.,* 1934.—The statistical friction of clean and also of smeared surfaces of mica has been investigated and the coefficient of friction measured. The Coulomb law is found to be strictly obeyed. For clean freshly prepared mica surfaces μ is approximately 1·0, but repetition of the measurements with the same surfaces causes the μ-values to fall to 0·4–0·5, which is due to surface damage and dispersion. Smearing the mica surface with water depressed the μ-value to 0·2, and an addition of NaOH lowered the friction still more. The liquids which are usually good lubricating agents, such as oleic acid, isoamyl alcohol, etc., are, however, less effective than water, *e.g.*, for isoamyl alcohol, $\mu = 0{\cdot}75$. Experimental facts, together with simple considerations lead to the proposition that in statical friction the lubricating layers possesses a thickness of several molecules. The anomalous properties of thin liquid layers may thereby receive an explanation. H. H. Ho.

4902. Absolute Method of Determining the Coefficient of Viscosity in Liquids. A. Sokolskij. *Comptes Rendus de l'Acad. des Sciences, U.R.S.S.* 3. 5. *pp.* 341–347, 1934. *In English.*—The author discusses first former methods using concentric cylinders or a falling sphere and the difficulties encountered. The viscosimeter used is based on the principle of the torsion balance with a cylindrical rod suspended by wire and rotated at a known rate. A formula for the absolute coefficient of viscosity (η) is worked out. The liquid employed, dehydrated glycerine, is placed in a thermostat and the rod suspended in it. Values of η obtained by this method are compared with those found by Stokes' method in a Jacobs and Gibson's viscosimeter, and those given by Ley and Kirchner's data, and good agreement results. R. S. R.

See also Abstracts 4839, 4892, 5203.

ASTRONOMY AND ASTROPHYSICS.

ASTRONOMICAL APPARATUS AND OBSERVATORY EQUIPMENT.

4903. Aluminium-Surface Mirrors in Astronomy. H. S. Jones. *Nature*, 134. *pp.* 522–523, *Oct.* 6, 1934.—The author traces the evaporation process from the year 1890 (Edison) through 1928 (Hochheim: Al-Ag alloy), 1931 (Strong and Kruger: pure Al) and (R. C. Williams: Cr), 1932 (Cartwright and Strong: many metals as well as quartz and fluorite). These last protected a silvered surface with quartz less than one wave-length in thickness and it remained untarnished by H_2S. Results obtained in the ultra-violet have been obtained at the 1932 August 31 eclipse, by the Lowell Observatory Cr-surfaced 15-in. mirror, and in the spectra of Planetary nebulæ and of 97 stars. [See Abstracts 3572, 3573 and 3581 (1934).] A Bibliography is given. A. S. D. M.

4904. Accuracy of Stellar Positions from Photographic Plates Treated by the Normalising Process. P. van de Kamp and A. N. Vyssotsky. *Astrophys. J.* 80. *pp.* 302–313, *Nov.*, 1934.—Twenty photographs of the central part of the Præsepe cluster have been taken with the 26-in. McCormick refractor on Cramer Iso Presto plates. Half of these plates had been " normalised " before exposure by soaking them in water, followed by dehydration in alcohol. The positions of 52 stars were measured. From a study of the 2080 residuals obtained with respect to the means of five plates, it is found that the normalising process results in a considerable increase in positional accuracy for stars near the edge of the plates. For the remaining area of the plate, the process gives an appreciable increase in positional accuracy for one emulsion, but causes no improvement for the second emulsion. Investigations are being continued to ascertain the relative frequency of emulsions free from stress, among plates of the same brand. AUTHORS.

See also Abstracts 4909, 4925.

COMETS AND METEORS.

4905. Elements of Comet 1933 *f* (Whipple). C. M. Anderson, Jr., and P. S. Riggs. *Lick Observat., Bull. No.* 463, *pp.* 33–35, 1934.

4906. Arizona Expedition for Study of Meteors. Parts II–V. E. Öpik and S. L. Boothroyd. *Harvard Coll. Obs., Circ. Nos.* 388, 389, 390, 391, [68 *pp.*], 1934.—In Part I the methods and aims of this expedition were set forth [see Abstract 1908 (1932)], and its results are now discussed. About 22,000 meteors were recorded between October 1931 and July 1933, and a list of 279 radiants is given, which are shown to be real. From observations of velocities made with the specially designed " rocking mirror " apparatus, it appears that hyperbolic velocities are rather common among naked-eye meteors, and very frequent among those observed telescopically. (The apparatus used with the telescope will be described in detail in a future publication.) Velocities up to 200 km./sec. have been observed, and the percentage of high velocity meteors increases with decreasing brightness. For October and November 1931, practically all members of group radiants belonged to our solar system, and practically all sporadic metors were of interstellar origin. M. A. E.

See also Abstracts 4779, 4916.

COSMOGONY.

4907. Formation of Galaxies, Stars and Planets. G. Strömberg. *Astrophys. J.* 80. *pp.* 327–343, *Dec.*, 1934.—The galaxy is supposed to have been formed from a primordial gas, extending to distances greater than its present dimensions. The original motions in the gas may be of any kind; in any case, continuous, fluid motion will gradually be established, owing to viscous forces, if the mean free path of the particles of which the gas is composed is smaller than the dimensions of the system. The hydrodynamical laws can then be applied. This implies also that the particles are exceedingly small (atoms or molecules). It is assumed that an approximately steady state of motion is developed, such that the velocities everywhere can be regarded as a finite, continuous, and single-valued function of position, and that the time enters only in small terms of the first order. This assumption excludes systems subject to periodic changes. It is shown that, if these conditions are satisfied, and if we follow a portion of the gas in its motion, its scalar velocity does not change with time. The motions—at least in the interior of the system—are such that the system contracts, generally or locally. At the surface there is a loss of matter owing to escape of particles. The contraction proceeds until the gas has developed into one or more bodies. If the system originally had a finite angular momentum, the bodies formed rotate in the same direction. If the system has symmetry about the axis of rotation, the motions in the gas are circular in parallel orbits. If smaller condensations are formed before the larger ones have been developed, the system is very flat. The stars formed after the steady state has been reached also move in circles about the axis and in a common plane. Stars formed before this state was reached may have any rotation and any motion, but the velocity must be less than that of escape. If the relative motion of two massive condensations is circular, then, as long as the gaseous envelope has sufficient density, the motions in the gas are along " surfaces of zero relative veclocity " with constant scalar velocity. Smaller bodies formed from this envelope move in the same way, but only bodies formed close to a primary can retain this motion after viscous forces and pressure gradients are no longer acting. It is suggested that retrograde satellites are either captured or formed from the gas when in a locally stable state of retrograde motion corresponding to a near coalescence of the two loops in the known periodic orbits in the problem of three bodies. Application of the theory to the solar system indicates that the planets were not formed *in situ* but at great distances from the sun. The theory seems to account for the existence of nearly circular orbits for the massive planets and for the general behaviour of the motions of the asteroids and the satellites. If the gas from which the planets were formed was once in the interior of the sun, it may have been expelled either during an encounter with another star or during an explosion like that of a nova. On the first alternative, planetary systems are very rare; on the second, they are a very common phenomenon in the universe. AUTHOR.

See also Abstract 4779.

LATITUDE AND LONGITUDE.

4908. Meridional Instrument of High Accuracy with Optical Self-Registering Micrometer. R. Baillaud. *Bull. géodésique,* No. 41. *pp.* 1–25, *Jan.-Feb.-March,* 1934.—In the apparatus described it is sought to eliminate the personal equation and the equation of magnitude in observations made with the prismatic astrolabe. For the meridional instrument with the use of a micrometer and automatically moving cross wires these errors are completely eliminated. The principles of the instruments differ and also the methods of observation and the relative reduction one to the other. For the prismatic astrolabe results are exempt from instrumental errors except for second and higher orders and are thus negligible. The principle of the new instrument is described, particulars are given of the use of the micrometer system, the rulings and methods of observation, and consideration is given to the elimination of the errors due to the personal equation and the equation of magnitude. R. S. R.

4909. Dependence of Accuracy on Latitude in Astronomically Determined Stations. J. Schive. *Bull. géodésique, No.* **42.** *pp.* **80–86,** *April–May–June,* **1934.** *In English.*—The problem of how the accuracy of an astonomically determined position varies with the latitude is discussed when comparing the accuracy of observations carried out at various latitudes. The mean square errors of longitude and azimuth should be multiplied by the cosine of the latitude in order to give the best comparable results. The problem of what is necessary to obtain a *required* exactitude in different latitudes is investigated. A comparative table is given, which shows, for example, that if 2 observation nights are required on lat. 45°, then on lat. 64° 6 observation nights should be required to obtain equal accuracy. W. A. R.

NEBULÆ.

See Abstracts 4907, 5017.

PLANETS.

4910. Constitution of the Atmospheres of the Giant Planets. A. Adel and V. M. Slipher. *Phys. Rev.* **46.** *pp.* **902–906,** *Nov.* **15, 1934.** —An analysis is made of the absorption spectra of the major planets: Jupiter, Saturn, Uranus, Neptune. Approximately forty of the rotation-vibration bands are identified as due to absorption by the methane molecule, and are correlated in terms of the fundamental frequencies of vibration. It appears that methane is the major constituent of the atmospheres of these distant bodies, the quantity in the absorbing strata increasing markedly from Saturn to Neptune. The absence of any appreciable amount of other hydrocarbon material is demonstrated. AUTHORS.

See also Abstract 4907.

STARS.

4911. Photographic Determination of Mass Ratios of Visual Binaries. R. C. Huffer. *Astrophys. J.* **80.** *pp.* **269–281,** *Nov.,* **1934.**—By means of plates taken with the 40-in. refractor at epochs separated by 14 to 28 years, the mass ratios of 17 visual binaries have been determined. The masses of these and of all others with known mass ratios are computed and plotted on a mass-luminosity diagram. In general there is agreement with the Eddington curve, both in the positions of the points on the chart and in the mass ratios as indicated by the slopes of the lines joining the two components of the pairs. The values of the mass ratios are plotted as functions of spectral type, period, total mass of the system, and difference of magnitude of the components. AUTHOR.

4912. Photographic Magnitudes of Proper-Motion Stars. H. C. Willis. *Astrophys. J.* 80. *pp.* 319–326, *Dec.*, 1934.—This paper describes the determination of photographic magnitudes on the international scale of 203 stars of large proper motion between magnitudes 8 and 16. The instruments used were the 60-inch reflector and the Ross 5-inch refractor. AUTHOR.

4913. Fluorescence in Hα and Hβ. R. v. d. R. Woolley. *Observatory*, 57. *pp.* 345–346, *Nov.*, 1934.—A correction. [See Abstract 3190 (1934).]

4914. Stellar Spectra in the Region 6562-7593 A. F. E. Roach. *Astrophys. J.* 80. *pp.* 233–258, *Nov.*, 1934.—On grating spectrograms of Procyon, Arcturus, Aldebaran, and Betelgeuze, 426 stellar lines have been measured in the region between Hα and the head of the atmospheric A band. Satisfactory identifications of a large number of the lines have been made. In Vega and Sirius this part of the spectrum has 33 lines, most of which are not strong. Radial velocities deduced from the measures of the first group of stars are found to agree with the values obtained for the ordinary spectral region. Lines of the following elements are definitely present: H, Al, Si, S, Ca, Ti, V, Cr, Fe, Zr. The unblended lines of neutral silicon are weakened appreciably in the cooler stars. Three lines of neutral sulphur are found in Procyon, strengthening the case for this element in the sun. Titanium is represented by 29 lines, of which 17 are probably unblended. They are prominent in the red stars. TiO bands of the red infra-red system are very strong in Betelgeuze and moderately so in Aldebaran. Iron contributes to about 150 stellar lines in this region. In the cooler stars the low excitation lines are enhanced relative to those of high excitation potential. In Procyon the converse is true. 24 lines are attributed to neutral zirconium. AUTHOR.

4915. Analysis of Nova Emission Bands. O. C. Wilson. *Mt. Wilson Observat. Contrib. No.* 500. *Astrophys. J.* 80. *pp.* 259–268, *Nov.*, 1934.—It is assumed, following Gerasimovič and Chandrasekhar [see Abstracts 513 and 2797 (1934)] that nova emission bands originate in spherical expanding gaseous envelopes having internal velocity gradients; also that the matter in the envelope is transparent to its own radiation and that Chandrasekhar's occultation effect may be nelgected. A method is then developed by which the velocity gradient can easily be found from the observed band shapes; all that is required is a simple integration. The analysis is applied to the hydrogen emission contours recently measured in the spectrum of RS Ophiuchi. AUTHOR.

4916. Cosmic Continuous Spectra and Electron Radiation. W. Finkelnburg. *Astrophys. J.* 80. *pp.* 313–318, *Dec.*, 1934.—Continuous radiation emitted by electrons interacting with positive ions must be taken into consideration in explaining many cosmic continuous spectra. The difficulties in calculating the intensity of this radiation are discussed, and it is pointed out that radiation of fast electrons, *i.e.*, electrons—whose velocity and number are not in equilibrium with the temperature of their layer, must play an important rôle. The possible influence of this effect on the spectra of the sun, the fixed stars, the corona, the comets, daylight, and some gaseous nebulæ is briefly discussed. AUTHOR.

4917. Spectrophotometry of RS Ophiuchi (Nova Ophiuchi No. 3). O. C. Wilson and E. G. Williams. *Astrophys. J.* 80. *pp.* 344–364, *Dec.*, 1934.—From one good plate taken with the three-prism violet spectrograph on August 30, 1933, the apparent colour temperature of RS Ophiuchi is found to be 4000° K. Contours of the hydrogen emission bands have been determined from several plates covering the period August 16–September 11, 1933. On the assumption that the red sides of the bands present the true unmodified shapes, the following facts emerge: (*a*) The contours are roughly exponential in form. The earlier ones can be represented approximately by the formula $\mathrm{I} = e - (u/u_0)^n$, where $n = 1 + k(u_0/u) - k$ and $h = 0\cdot125$. The value u_0 decreases rapidly with time at first, then more slowly, finally attaining a more or less constant value; k also decreases and may be considered to vanish for the later contours. (*b*) In addition to a sharp absorption component present on the short-wave-length sides of the band maxima in the early stages, there appears to be a general deficiency of intensity over the violet halves of the bands relative to that of the red halves. The supposition that this is due to the complete suppression of the continuous spectrum under the violet sides is not in entire agreement with the facts, but there may be complicating factors. This hypothesis would require a large velocity range among the atoms directly in front of the star, and leaves no room for the monochromatic hydrogen absorption components or for the sharp nebular lines. It is suggested that the latter arise in a quiescent shell around the star left over from its previous outburst. The Balmer decrement has been obtained from two accordant plates, and is found to be appreciably faster than the mean of those found by Plaskett and by Berman for planetary and diffuse nebulæ. The observed decrement is brought into good agreement with the latter by applying the differential factors necessary to reduce a true temperature of 35,000° to an apparent one of 4000°. From several spectrograms it appears that the ratio of the area of Hγ to the intensity in the underlying continuous spectrum not vary greatly between August 16 and September 2, 1933. Zanstra's method gives a photoelectric temperature of 35,000°, calculated from the measures on plate V404, August 18. If this is a real measure of the temperature, it follows from the above that, while the star decreases in brightness by about two magnitudes from August 16 to September 2, its temperature remained constant. This conclusion would imply that the fading of the star was due to a shrinkage in the radiating surface. From the measured intensity of the K line, with an approximate allowance for a probable stellar blend, a distance of 1060 parsecs is deduced. An independent method, based on the space-reddening result of Stebbins and Huffer, gives 1300 parsecs. In spite of the difficulties involved in these computations, their agreement suggests a likely distance for RS Ophuichi of about 1200 parsecs. AUTHORS.

4918. Spectroscopic Binary α Virginis. O. Struve and E. Ebbighausen. *Astrophys. J.* 80. *pp.* 365–376, *Dec.*, 1934.—New elements are derived for Spica: $P = 4\cdot014160$ days; $e = 0\cdot10$; $\omega = 40°$; $K = 126\cdot8$ km./sec.; $K_2 = 202$ km./sec.; $\gamma = +0\cdot5$ km./sec.; T = J.D. 2426041·26. The period has been constant since 1891. The longitude of periastron seems to have advanced approximately 70° since Baker's observations in 1907–1908. The intensities of the absorption lines of both components vary; each component is strongest when its velocity is at minimum. The total absorption of the fainter component varies in a range of 1·7 to 1, while for the stronger component the range is 1·4 to 1. Three possible explanations are discussed. The interstellar K line is extremely weak. AUTHORS.

4919. Ursa Major Group. J. J. Nassau and L. G. Henyey. *Astrophys. J.* 80. *pp.* 282–301, *Nov.*, 1934.—An expedient method is developed for finding stars which have a given common motion. It is essentially based on the stereographic projection of the circles of equal radial velocity and equal cross-motion in declination. The method is applied in an examination of all stars in the *Yale Bright Star Catalogue* having complete data (radial velocity, proper motion, and parallax) for possible membership in the Ursa Major Group. This examination yielded 126 stars, each of which differed from the assumed velocity of the group by a vector whose magnitude was less than 9·5 km./sec. The mean velocity of the group in galactic coordinates, with solar motion excluded, was found to be $l = 1^\circ\cdot 4$, $b = -6^\circ\cdot 0$, $V = 29\cdot 5$ km./sec. The space distribution of the stars is more or less spherical. A study of the spectral and parallactic distribution shows that the selection is not at random. As compared with the spectral frequency of stars having complete data, the Ursa Major stars exhibit a gradual increase in number from M to A with half of them A types, and a complete absence of B-type stars. The Russell diagram shows all the characteristics of a type 2 *a* open cluster in Trumpler's classification. The stars in space are divided into two groups by a gap 18 parsecs wide and passing through the sun. AUTHORS.

4920. Changes in Period of Cluster-Type Variables. Discussion of Photographic Observations. S. I. Gaposchkin. *Harvard Coll. Obs., Circ. No.* 192. [7 *pp.*], 1934.—The author considers three methods of discovering change of period. (1) Method of single maxima. (2) Method of single light curves: the weakest part of both is that an arbitrary "mean period" is the basis for the deduced changes of period and this "mean period" is not the mean period for all time, but is determined over a finite interval. (3) Combination of the two previous methods. The best mean period for the whole time interval (30 to 35 years) is determined as in (1), and 8 or 9 mean light curves then formed, being distributed more or less uniformly throughout the time interval so that each light curve embraces from 4000 to 6000 cycles; and then mean periods as in (2). The errors of the deduced periods must be found but not estimates as in the methods of least squares. The stars: SW Andromedæ, S Aræ, UU Hydræ, RW Cancri, RR Leonis and V Leonis Minoris are so discussed, but no convincing evidence for a change of period could be obtained for any of them. A. S. D. M.

See also Abstracts 4904, 4907, 5138.

SUN.

4921. Solar Prominence of July 18, 1933. P. Rudnick. *Astrophys. J.* 80. *pp.* 377–382, *Dec.*, 1934.—Thirty-seven calcium spectroheliograms taken with the 40-inch refractor on July 18, 1933, give the history of an active prominence over a period of five and one-third hours. The prominence consisted mainly of very low arches. The motions are described in some detail, and are correlated with spectrohelioscope observations of radial velocities. The movements appear to be connected with the development of two centres of attraction quite near the limb. During the period of observation the prominence involved and distorted a neighbouring quiescent prominence. Blink comparator measures give internal velocities up to about 60 km./sec. for a few knots, although most of the velocities measured were less than half that value. The prominence when considered in detail shows some turbulence. However, the majority of the displacements measured were nearly parallel to the limb, as the material was moving along the flat arches making up the prominence. Some measurements of motions and heights of the quiescent prominences were also made. AUTHOR.

4922. Effect of Atmospheric Transparency on Comparison Results of two Pyrheliometers. C. E. Brazier, I. Mašek and R. Guilhen. *Comptes Rendus*, 199. *pp.* 644–646, *Oct.* 1, 1934.—Observations of solar intensity by two pyrheliometers, the Abbot and the Marvin belonging to the Geophysical Institut of Paris University, give results the differences in which cannot be explained as due to errors of observation. From an examination of the data the authors are able to establish a relation $m/a = 0{\cdot}822 + 0{\cdot}213\ p$ (m = Marvin), (a = Abbott), p being the apparent coefficient of transparency of the atmosphere. The radiation observed consists of two parts, direct from the sun and indirect from the sky. The arrangement of diaphragms limiting the aperture for admission of radiation differs in different instruments. Consequently the amount of indirect radiation received differs from one instrument to another, or m/a should depend on p, as is found. Thus the geometrical arrangement of diaphragms in these instruments imposes a limit on the accuracy of the results of observations obtained by them. A. E. M. G.

4923. Diurnal and Annual Variation of Long-Wave Solar Radiation. N. N. Kalitine. *Comptes Rendus de l'Acad. des Sciences, U.R.S.S.* 3. *pp.* 348–353, *Aug.* 11, 1934.—Values were obtained at Sloutzk during the years 1929–30 of the long wave solar radiation using a RG_5 filter. It commences to transmit at 644 m. μ, rises to 96 % at 700 m. μ, touches 99 % at 2 μ and then falls off. Corrections for absorption and reflection in the filter are applied to get absolute values in cals./min. $cm.^2$ A table and curves show the mean intensity for each hour at the middle of each month for perpendicular and horizontal surfaces. The influence of water vapour absorption is shown best by the perpendicular surface at midday. Although radiation from the sun would increase from Jan. to June and then decrease the table shows for long wave radiation the mean maximum is in April and a secondary maximum in Sept.–Oct. while the main minimum is in Dec. and a secondary minimum in Aug. These differences are due to changes in the amount of water vapour in the atmosphere. Because of this the annual variation of intensity for long wave radiation is 19 % while that of total flux is 38 %. R. S. R.

4924. Variations in the Solar Period of Rotation. G. Abetti. *Accad. Lincei, Atti*, 19. *pp.* 836–839, *June* 17, 1934.—During the past eighty years the rotation period of the sun, as measured by the travel of sunspots, appears to have remained constant at 25·02 days. This method is, however, hardly precise. The spectrographic method is replacing it. This shows an equatorial velocity of 2·05 km./sec. instead of 2·02. Since 1909 there would, according to this method, appear to have been a somewhat brusque fall in the equatorial velocity, to below 2·00 km./sec. This has raised questions as to variability in the period of the sun's rotation, which the author discusses; pointing out that the spectrographic method may have inherent defects arising from variation in wave-lengths associated with sunspots, magnetic storms, etc. A. D.

See also **Abstracts 4913, 4916, 4942, 4951.**

GEOPHYSICS.

GEODESY.

4925. Graduation Errors in Circles Used for Geodetic Work. J. Baillaud. *Bull. Géodésique. No.* 42. *pp.* 37–68, *April–May–June,* 1934.—Consideration of the errors arising from the graduation of circles used for geodetic surveys shows that they are by no means negligible. It is considered that these errors are responsible for a good third of the mean quadratic error in the measurements of angles to determine the new meridian of France. A preliminary study of circles would have involved less work than the innumerable repetitions of triangulation measurement, and would be more efficacious. The author recommends a fresh method of repetition of angles in observing. W. A. R.

See also Abstracts 4852, 4853, 4863, 4908, 4909.

GEOPHYSICS, APPLIED.

4926. Progress of Electric Coring. A. Belluigi. *Com. Geod. e Geofis., Boll.* 4. *pp.* 60–63, *July,* 1934.—The method of electric coring is explained and discussed and its value in prospecting for minerals and especially for petroleum is considered. An example of coring in which there are alternate strata of petroleum and water-bearing rocks, shows that errors in the interpretation of results as well as in the measurement, may occur. H. M. B.

4927. Mineral Prospecting. H. Löwy. *Phys. Zeits.* 35. *pp.* 745–746, *Sept.* 15, 1934.—Electrical prospecting for ore embedded in a medium which is very dry, and therefore relatively non-conducting, is only possible by electromagnetic radiation methods. If the ore has a continuous surface, it reflects the waves and acts as a screen against quantitative determination of the ore content. If, however, it is disseminated, its effect is to increase the dielectric constant of the medium, and the increase is proportional to the quantity of ore. The author discusses various formulæ for calculating the quantity of ore from the measured increase in dielectric constant as compared with ore-free medium, and presents his own formula $(\bar{\epsilon} - 1)/(\bar{\epsilon} + 2) = (\epsilon_1 - 1)(1 - V_2)/(\epsilon_1 + 2) + V_2$, where $\bar{\epsilon}$ is the dielectric constant of the aggregate of ore plus rock medium, ϵ_1 is the dielectric constant of the rock medium and V_2 is the total volume of ore in unit volume of aggregate. The practical validity of this formula is discussed in the case of the capacitative method of geoelectrical prospecting, when the dielectric constants are determined by frequency measurements. The frequency must be measured within the quasi-stationary region of the field of the antenna. A wave-length of the order of 1000 m. is suitable. E. L. J.

4928. Automobile Radio Reception as an Aid in Geologic Mapping. E. Cloos. *Am. J. Sci.* 28. *pp.* 255–268, *Oct.,* 1934.—Recent experiments have proved that the quality of wireless reception from certain stations is influenced by geological conditions. Structural disturbances such as faults or steeply dipping rock contacts cause " dead spots." A radio survey of such localities gives valuable indications for determining geologic structure on the one hand and for guiding the installation of radio sets and transmitting stations on the other. A small alteration in an ordinary automobile radio set is sufficient for determining such disturbances quantitatively and qualitatively. AUTHOR.

4929. Report of the Fifteenth Annual Meeting of the American Geophysical Union. *Am. Geophys. Union, Trans. Parts I and II.* [634 *pp.*], 1934.

HYDROSPHERE, PHYSICS OF THE.

4930. Penetration of Light into Sea. F. Lauscher, E. Friedl and E. Niederdorfer. *Gerlands Beitr. z. Geophys.* 42. 4. *pp.* 423–429, 1934.—Series of comparative measurements were obtained at the surface and at various depths up to 1500 cm. in lakes near Lunz with a Ag-Se photoelectric cell, of the brightness of the transmitted light. The results are tabulated and shown graphically. Measurements were made with the sky covered by cirro-stratus cloud, during rain, and with an almost clear sky. It was found that sunlight was transmitted much better than diffused light and the transmitted light with cirro-stratus cloud equalled that during rain. Values are given also for diurnal differences in the transmission with cirro-stratus cloud. R. S. R.

LAND, PHYSICS OF THE.

4931. Constitution of the Earth. G. E. Marsh. *Gerlands Beitr. z. Geophys.* 42. 4. *pp.* 430–446, 1934. *In English.*—The author assumes an earth composed of an outer granitic shell, a middle basaltic shell and a metallic core, with a mean density of 5·52, moment of inertia $9 \cdot 09 \times 10^{37}$ kg. m.^{2} and a surface density of plutonic rocks of 2·75. He postulates the conditions for these three layers. Curves are applied to obtain mean values for the radius, and density of each layer and the data obtained are supported by earthquake observations. The radii and densities at the boundaries are found and a diagram gives these values while an empirical law for the relation between density and depth for each shell is obtained. The metals in the middle layer and central core are stated. Finally, a curve for pressure and depth is obtained from the radii and densities. R. S. R.

4932. Stability of Continental Crust. T. Terada. *Tokyo Univ. Earthquake Research Inst., Bull.* 12. *pp.* 451–459, *Sept.*, 1934. *In English.*—The author considers that a uniform concentric spherical shell on the earth as pictured by earlier writers cannot be absolutely stable but may tend to crumple up into detached pieces due to its own gravitation, provided that a certain necessary condition be fulfilled. It is first shown that the crustal shell cannot crumple of its own accord since it leads to an increase of potential energy. Next contraction may be assisted by cooling of the core and possible flow of the " sial " crust mass and the viscous underlying " sima." This is a possible explanation for the circum-Pacific mountain ranges, the adjoining deeps and the drift of continental masses. A rough estimate is obtained of the pressure difference produced when a circular hole is opened in the sial crust. R. S. R.

4933. Elastic Properties of Rocks. R. W. Goranson. *Washington Acad. Sci., J.* 24. *pp.* 419–428, *Oct.* 15, 1934.—The causes of error in the experimental determination of the elastic properties of rock and of differences between such and those deduced from seismological observations are discussed and illustrated from previous results. Such causes are the inhomogeneity of the rock, strains due to rapid cooling, hysteresis with elastic afterworking and permanent set, and the disturbing effect of separating the specimen examined from the parent mass. It is concluded that a volume method gives more reliable results than a linear one. To get reliable low pressure results all irreversible phenomena must be eliminated, *e.g.*, by a preliminary seasoning of the sealed specimen at a high hydrostatic pressure; but better data for extrapolation to high pressures (> 12 kilobars) are obtained by calculating compressibility from the volume composition. Results showing the best agreement with seismic determinations are obtained by extrapolating from high pressure experimental determinations. [See Abstracts **4418, 4419** and **4420** (1933).] C. A. S.

See also Abstracts **4790, 4927, 4928, 4943.**

METEOROLOGY.

4934. Origin of Atmospheric Ozone Researches at Scoresby Sound During the Polar Year. A. Dauvillier. *J. de Physique et le Radium*, 5. *pp.* 455–462, *Sept.*, 1934.—In this contribution the author outlines in more detail subject matter already referred to [see Abstract 545 (1934)]. Full particulars are given as to the chemical method of determining the amount of ozone in the air, while a diagram and photographs illustrate the apparatus used. The results obtained are set out graphically. The author concludes that the auroral theory of origin gives the only satisfactory interpretation of the observed facts.

A. E. M. G.

4935. Ozone Content in the Atmosphere, near Shanghai. P. Lejay. *Comptes Rendus*, 199. *pp.* 879–881, *Oct.* 29, 1934.—Using Dobson's spectrograph method, the author has made determinations of ozone content from Jan. 1932, onwards, at a post 25 km. south of Shanghai. For each determination two couples of rays are used, 3264–3022, and 3232–3062 Å. From an examination of the results it is concluded (1) that an annual variation exists, maximum about March minimum in November. This variation is represented graphically for 1932 and 1933. (2) Besides the annual variation there are many minor variations. These, it is considered, afford information regarding the movements of masses of air. Also reasons are given for different results being found from those obtained in Europe with similar pressure distributions. A. E. M. G.

4936. Radon Content of the Atmosphere. F. Becker. *Gerlands Beitr. z. Geophys.* 42. 4. *pp.* 365–384, 1934.—The content of radon was determined by means of Israel's apparatus wherein the air examined is filtered and dried and whereby complete measurements can be made at 2 hr. intervals. Series of measurements were taken over periods of 24 hr., the air being taken in at 0·2, 1 and 13 m. above the ground at Frankfort-on-Main and on the Taunus (820 m.). Results show the radon to be derived from the soil, the amount detected depending on the state thereof and of the atmosphere. It is more in summer than in winter, least when the soil is frozen, wet or snow-covered, most in calm warm weather when a maximum is observed very early in the morning, a minimum about midday. Rain, dew or hoar frost cause some diminution. In windy weather there is little variation in the 24 hrs., but the amount is less when the wind comes from across the sea. The amount at 13 m. is very dependent on convection currents. Measurements in a cellar showed inexplicable variations. Observations during an inversion show air from a height to be almost free from radon. [See Abstracts 2402 and 3207 (1934).] C. A. S.

4937. Radon and Aerosol. H. Israel. *Gerlands Beitr. z. Geophys.* 42. 4. *pp.* 385–408, 1934.—Determinations of the amount of radon in the atmosphere are vitiated by the fact that atoms thereof are to a variable and so far unascertained degree, adsorbed by atmospheric nuclei. These, with any adsorbed radon, are removed more or less, by filtration, cooling in liquid air, and other processes employed in the estimation of radon. The free path of the emitted α-particles (and consequently the ionisation) is liable to be less when the radon atom is adsorbed by a nucleus. Experiments showing the variable results obtained are described. A count of nuclei seems a necessary concomitant of an estimate of the radon content. C. A. S.

4938. Winds of Superhurricane Force, and a Heated Anemometer for their Measurement during Iceforming Conditions. S. Pagliuca, D. W. Mann and C. F. Marvin. *Monthly Weather Rev.* 62. *pp.* 186–195, *June*, 1934. *Am. Meteorolog. Soc., Bull.* 15. *pp.* 172–174, *June–July*, 1934.—A method of measuring the extremely high winds on Mount Washington, N.H., by a specially constructed electrically-heated type of anemometer is described. The results obtained by it during the storm April 11–12 1934, are discussed and the behaviour of the instrument illustrated by a reproduction of the wind velocity record for these dates. The instrument is fully described and its internal construction illustrated with the help of several photographs. The testing and the calibration of the instrument both before and after the storm are discussed. The latter test includes the effects of tilting the axis and of turbulence. The computation and extrapolation of test data are indicated and from a critical analysis of the curve referred to above it is found that maximum travel in 5 min. must have ranged from between 251 and 274 indicated m.p.h. A. E. M. G.

4939. Salinity, Nuclei of Condensation and Precipitation. M. Bossolasco. *Com. Geod. e Geofis, Boll.* 4. *pp.* 54–59, *July*, 1934.—Determinations of the salinity of the air at Mogadoxo, during the N.W. monsoon, are in good agreement with Köhler's law, obtained from numerous measurements made in Scandinavia. The relation between the salinity and the number of nuclei is discussed in order to justify the scarcity of nuclei over seas and oceans and the abundance of them in continental regions. Finally, with regard to the coast of Somaliland, the relation between the nuclei of condensation and the formation of mist and precipitation are examined. H. M. B.

4940. Dustfall of December 15–16, 1933. L. R. Page and R. W. Chapman. *Am. J. Sci.* 28. *pp.* 288–297, *Oct.*, 1934.—A description of the meteorological conditions during the time of the dustfall is given. The area over which it fell and a rough estimate of the total weight are indicated. Thereafter the authors discuss the results obtained from a microscopic examination of the deposit. This leads to a consideration of the possible origin of the dust, wherein it is concluded that the most likely source is the south-western states of America. A chart illustrates the path of the storm. A. E. M. G.

4941. Sensitiveness of Anemometers. S. P. Fergusson. *Am. Meteorolog. Soc., Bull.* 15. *pp.* 95–99, *April*, 1934.—Comparative tests of the 4- and 3-cup Robinson's anemometer, a Richard kinemometer (windmill) and a similar mill constructed of balsa wood and so only one-fifth as heavy, in a controllable air current variable to the extent of 20 % (60 % for the balsa wood mill) by a screen movable in 0·1 sec., showed the 3-cup to be more sensitive than the 4-cup machine, the kinemometer twice as sensitive, and the balsa wood mill the most sensitive rotation anemometer so far devised. As regards evenness of scales the 3-cup was very definitely superior to the 4-cup anemometer, but the balsa wood mill was superior to both. C. A. S.

4942. Continuous Sunshine Recorder. L. F. Miller. *Rev. Sci. Instruments*, 5. *pp.* 405–407, *Nov.*, 1934.—The instrument consists of a thermocouple, one junction placed in a pyrex bulb, the second, round which is a thin silver sphere coated with lamp black, placed in a quartz bulb. The free ends of the junction are connected to a recording galvanometer. The arrangement and method of recording results are described and illustrated by diagram. Records obtained on days differing largely meterologically are reproduced and a comparison table gives results obtained over a period against those found for the same period by the Weather Bureau Standard method. It is hoped to arrive at a fuller interpretation of the records obtained by further investigation. A. E. M. G.

See also Abstracts **4922, 5195.**

SEISMOLOGY.

4943. Seismic Waves and the Crustal Structure of the Pacific Region. D. S. Carder. *Seismological Soc. of America, Bull.* 24. *pp.* 231–302, *July*, 1934.—Love waves of earthquakes in the Pacific area have been examined. Speeds over oceanic paths are higher than over continental paths, the difference diminishing with the wave-length. The data show that under Western North America the crust has 20 km. of granite overlying 40 km. gabbro; under the Aleutian deep basalt 25 km. and dunite 20 km.; under Polynesia basalt 30 km., and dunite 25 km. The behaviour of the earthquake coda is also discussed. W. A. R.

4944. Transient Motions of a Pendulum Due to an External Vibration. C. Tsuboi. *Tokyo Univ. Earthquake Research Inst., Bull.* 12. *pp.* 426–445, *Sept.*, 1934. *In English.*—While the seismograph indicates the sense of the initial earthquake motion it does not give correctly the time and amplitude of the maximum motion since the vibration of the pendulum is still transient and not stationary. A correction is required to interpret correctly the initial part of the record. A mathematical treatment is given for the motion when the pendulum is excited from its original state of rest by an external vibration, sudden or gradual in its commencement. R. S. R.

4945. Harmonic Analysis of Damped Vibrations. F. Kishinouye. *Tokyo Univ. Earthquake Research Inst., Bull.* 12. *pp.* 446–450, *Sept.*, 1934. *In English.*—The period of damped vibrations is investigated by the method of harmonic analysis for (1) an amplitude decreasing exponentially, (2) free vibrations of a pendulum with large solid friction, and (3) damped vibrations with a different curvature for the guiding curve. Curves illustrate the analysed vibrations and certain properties of the amplitudes of harmonics are obtained. The methods have application for the effects of damping of seismograph pendulums, vibrations of the surface layer, and frequencies of swarm-earthquakes and after-shocks, as well as to problems in acoustics and some branches of physics and engineering. R. S. R

4946. Vibration of Buildings and Reinforced Concrete Chimneys due to Earthquake Motion. T. Fukutomi. *Tokyo Univ. Earthquake Research Inst., Bull.* 12. *pp.* 492–516, *Sept.,* 1934. *In English.*—As a result of mathematical calculation for an ideally simple structure the ratio of the amplitude of the forced vibration of the building to that of the earthquake motion causing this vibration is plotted against the ratio of the natural period of the building to that of the earthquake motion for different assumed values (1–3) of the damping ratio for (1) lateral, (2) shearing, and (3) rocking motion of the building. The results are applied to seismograms obtained in various buildings, and the damping ratio deduced. This is 1·34–2·2 for 7–9 storied steel framed reinforced concrete buildings, 1·48–1·62 for a three-floored wooden building, and 1·05–1·07 for reinforced concrete towers or chimneys 22–45 m. high. In general (1) predominates in buildings such as tall chimneys, (2) in buildings of medium height, and (3) in rigid buildings. [See Abstract 2337 (1929).] C. A. S.

4947. Earthquakes Associated with the 1933 Eruption of Mauna Loa, Hawaii. A. E. Jones. *Washington Acad. Sci., J.* 24. *pp.* 413–418, *Oct.* 15, 1934.—A list of the most important shocks is given. Small local shocks are thought to be often generated by flowing lava. There is a slight tendency for epicentres to become progressively shallower up to the time of eruption. About one-seventh of located epicentres were submarine, mostly on the submarine slopes of the island. Some were on quiescent volcanoes, and the remainder on the active volcanoes. A few can be definitely connected with rifts. Shocks in the crater may accompany or precede eruptions, but are more often caused by movements deep in the volcano. W. A. R.

4948. Magnetic Damper. T. Hagiwara. *Tokyo Univ. Earthquake Research Inst., Bull.* 12. *pp.* 482–491, *Sept.,* 1934. *In English.*—It is shown mathematically that the damping force is proportional to the velocity, thickness, and conductivity of the plate and to the square of the total magnetic flux, and inversely to the area of the field; the proportionality depends on the size and shape of the plate and of the poles of the magnet. The plate should be so shaped as to have its greatest extension in the direction in which it swings, and must be free from any magnetic material. C. A. S.

TERRESTRIAL ELECTRICITY AND MAGNETISM.

4949. Earth Field, Thunderstorms and Lightning. A. v. Hippel. *Naturwiss.* 22. *pp.* 701–712, *Oct.* 19, 1934.—The meteorological conditions giving rise to the convectional and cold front types of thunderstorms are first explained. The theories of Simpson and Wilson regarding the development of space charges in thunderstorm clouds are explained and the opposed conclusions to which they lead regarding the potential in different parts of the cloud. Simpson's theory regarding the growth of a discharge from the negative part of the cloud and the branching of the spark is dealt with and it is shown to be opposed to the observations with industrial plants and networks and the type of flash does not necessarily indicate the cloud polarity. Lichtenberg figures are used to provide an alternative explanation which is in agreement with Wilson's theory and the author gives reasons for supporting Wilson's views. R. S. R.

4950. Systematic Errors of a Magnetic Balance. J. Olsen. *Terr. Mag.* 39. *pp.* 173–186, *Sept.,* 1934. *In French.*—Analysis of the action of a magnetic balance in which the axis of rotation and the magnetic axis are not horizontal. It is shown that the errors thus introduced cause distortion in the registration of the diurnal motion due to the vertical intensity. Formulæ are derived for reduction of the sources of error in question. G. E. A.

4951. 27-Day Recurrences in Terrestrial Magnetic and Solar Activity, 1923-1933. J. Bartels. *Terr. Mag.* 39. *pp.* 201–202, *Sept.,* 1934.—A diagram is given, showing side by side, in a somewhat improved and simplified manner, the recurrence phenomena for the last sunspot cycle 1923–33, in terrestrial magnetic and solar activity using relative sunspot numbers for the central zone. The magnetic diagram is convenient in determining the sequences to which a magnetically disturbed or quiet day belongs, especially since it includes the period of the 2nd International Polar Year beginning Aug. 1, 1932. It also illustrates, in new observational material, the general results of the former paper [see Abstract 2954 (1932)]. The main purpose of the solar diagram is to invite comparison with the magnetic diagram and re-examination of the results obtained formerly. The last years 1930–33 illustrate again the fact that strong and long-lived magnetically active regions on the sun persist through long times in which the sun appears practically spotless, or that small or zero sunspot numbers comprise many different degrees of solar activity with respect to its geophysical influences. R. S. R.

4952. Earth-Currents. W. J. Rooney and K. L. Sherman. *Terr. Mag.* 39. *pp.* 187–199, *Sept.,* 1934.—Continuous registration of earth-current potentials was carried out at the station in Alaska from September, 1932, till March, 1934. One pair of lead electrodes was placed 1·28 km. apart on a due S.–N. line, and the other was 1·21 km. apart on a due E.–W. line. Records for a full year from October 1, 1932, were reduced. The most striking feature of the records is the comparatively great short-period fluctuations, often oscillatory, which occur almost exclusively at night, and the contrasting smoothness of the traces during daylight. The amplitude of the short-period oscillations frequently reaches 1 volt/km. or more. Corresponding in time to these pulsations at College there occur less conspicuous disturbances at Tucson, Arizona, and sometimes also at Huancayo, Peru. The mean diurnal-variation curve for the northward component shows a fairly smooth double oscillation in potential gradient with maxima at about 5 h. and 16 h. local time, and minima just before noon and midnight. Its mean diurnal range is about 14 mV/km. The eastward component is smaller and of opposite sign. The same type of diurnal variation persists throughout the year, being greatest in summer. [See also Abstract 3638 (1934).] G. E. A.

RADIOACTIVITY.

4953. Gamow's Theory and Radioactivity. H. Saïni. *Arch. des Sciences*, 16. *pp.* 80–101, *March–April*, 1934.—A lecture, giving an account of this theory in language as simple as is consistent with its mathematics, and brief accounts with Bibliography of recent work on the subject. C. A. S.

4954. Energies of α-, β-, and γ-Rays. H. A. Wilson. *Roy. Soc., Proc.* 147*A*. *pp.* 240–250, *Nov.* 15, 1934.—This paper contains a continuation of the discussion of the energies of α-, β- and γ-rays on the theory previously proposed by the writer [see Abstract 3230 (1934)]. The energies of β-rays from elements having the same atomic number are compared and it is found that they agree approximately in a number of cases in accordance with the theory. Pairs of β- and γ-rays energies having sums equal to multiples of 3·85 are found for several elements. The relative frequencies with which the different values of $\Sigma N_n E_n$ (N = integer, E_n = electronic energy level) occur in the observed energies are determined. It is found that K + 2L occurs most frequently. The internal conversion coefficients for the RaC′ γ-rays are considered and found to be consistent with the theory. The chance that the agreements with the theory are due to accidental coincidences is considered and shown to be very small. AUTHOR.

4955. Temperature Variation of the Total Ionisation in Air. Part II. A. Becker and Ilsemarie Schaper. *Zeits. f. Physik*, 91. 5–6. *pp.* 422–426, *Oct.* 5, 1934.—An earlier investigation [see Abstract 552 (1933)] of the total α-particle ionisation in gases is extended to a temperature range of − 180° C.–265° C., the voltage on the ionisation chamber being 6000. Current/voltage curves show a definite decrease of ionic recombination at high temperatures. J. E. R. C.

4956. Energy of β-Rays of Radium B. F. A. Scott. *Phys. Rev.* 46. *pp.* 633–640, *Oct.* 15, 1934.—The energy of the most intense β-ray line from RaB has been measured and found to be $2{\cdot}6145 \times 10^5$ electron volts, taking e/m to be $1{\cdot}760 \times 10^7$ e.m.u. per gm. The value of $H\rho$ for this line was found to be 1931·8 gauss cm. The spectrum was obtained by the magnetic focussing method and the magnetic field was measured by the Cotton balance method. All measurements were made to within 1 part in 10^4 and it is hoped that the error in $H\rho$ is not greater than this. The value for the energy of course depends on the value of e/m and hence may be in error by about 1 part in 10^3. AUTHOR.

4957. Measurement of Radioactive Deposits with Point- and Tube-Counters. A. Krebs. *Phys. Zeits.* 35. *pp.* 796–800, *Oct.* 1, 1934.—Various types of point- and tube-counters are described for use in determining the radioactive emanations deposited from the air on exposed wires. Precautions are given for avoiding falsification of the results obtained with a vacuum duant-electrometer used in conjunction with these counters, spurious ("spontaneous") deflections being due to radioactive infections of the instrument. Numerical results are given, which indicate the accuracy and the sensitivity of the methods used. H. L. B.

See also Abstracts 4783, 4936, 4937, 5188, 5190.

RADIATION.

ABSORPTION AND TRANSMISSION.

4958. Relative and Absolute Photoelectric Extinction Measurement. G. Kortüm and H. v. Halban. *Zeits. f. phys. Chem.* 190. *Abt.A.* 3–4. *pp.* 212–230, 1934.—The suitability of the photoelectric method for absolute and comparative extinction measurements is discussed, the influence of spectrally impure light on the results of the measurements being investigated for various cases occurring in practice. The apparatus and method of working are described. By means of a rotating sector or of polarisation prisms, an accuracy of 1–2 per cent is obtainable in the determination of absolute extinction coefficients, and one of 0·01 per cent in the comparison of two extinctions. This high relative sensitivity allows the method to be used for the determination of concentrations. The reproducibility of the results is illustrated by a series of measurements and the usefulness of the method is shown by means of the absorption curves of α-dinitrophenolate and their dependency on the temperature. T. H. P.

See also Abstracts 4930, 4959.

COLORIMETRY.

4959. Standardisation of Lovibond Red Glasses in Combination with Lovibond 35 Yellow. K. S. Gibson and Geraldine W. Haupt. *Bureau of Standards, J. of Research,* 13. *pp.* 433–451, *Oct.,* 1934.—The present paper describes the fundamental standardisation of Lovibond red glasses. The purpose of the standardisation was to derive new numerals for the Bureau glasses, approximately equal in magnitude to the original numerals but free from certain inconsistencies occurring among them. The standardisation is based upon spectrophotometric analyses of the glasses when in combination with Lovibond 35 yellow. The new numerals were derived from colorimetric computations based on the spectral transmission data, and they are shown to be on a consistent additive scale. This scale covers a range from yellow to yellowish-red. Tolerances of colorimetric purity and light transmission are considered. [See also Abstract 1973 (1934).] AUTHORS.

ELECTRO-OPTICAL AND MAGNETO-OPTICAL EFFECTS.

4960. Dispersion of the Electro-Optical Effect in Carbon Dioxide. G. G. Quarles. *Phys. Rev.* 46. *pp.* 692–693, *Oct.* 15, 1934.—The dispersion of the electro-optical Kerr effect in CO_2 has been studied from 4000 Å to 7500 Å. The results are in better agreement with the Langevin-Born theory than with that of Havelock. An absolute value of the Kerr constant B for CO_2 has been determined. This is $(0 \cdot 249 \pm 0 \cdot 003) \times 10^{-10}$ for a temperature of 17·5° C., a wave-length of 5890 Å and a pressure of one atmosphere. AUTHOR.

4961. Magnetic Circular Dichroism of Solutions of Copper Ammonium Hydrate and the Nitrate and Sulphate. R. Cordonnier. *Comptes Rendus,* 199. *pp.* 667–668, *Oct.* 8, 1934.—The magnetic rotations and magnetic circular dichroisms of solutions containing the $Cu(4NH_3)$

ion have been measured at wave-lengths in the blue and green of the visible spectrum. C. B. A.

4962. Verdet Constants of Cerous Chloride Solutions. F. G. Slack, R. L. Reeves and J. A. Peoples, Jr. *Phys. Rev.* 46. *pp.* 724–727, *Oct.* 15, 1934.—The Verdet constants of solutions of cerous chloride in water have been measured at concentrations varying from zero to an almost saturated solution. Measurements were made at temperatures from 10 to 45° C. and for the wave-lengths 5893, 5461 and 4481 Å. The results are given in the form of curves showing the Verdet constant as a function of temperature and as a function of concentration. Tabulated values of the concentration, density, index of refraction and Verdet constant of the solutions are also given. Attention is called to the point that the effect attributed by Allison and Condon to a time lag in the Faraday effect may have been due to a temperature change during the course of their observations. AUTHORS.

4963. Magneto-Optic Method of Chemical Analysis. F. G. Slack. *Frank. Inst., J.* 218. *pp.* 445–462, *Oct.*, 1934.—After repeated tests of this method [see Abstract 807 (1931)], concerning which there has been much controversy, no physical basis has been found. T. H. P.

See also Abstract 4667.

FLUORESCENCE AND PHOSPHORESCENCE. LUMINESCENCE AND AFTERGLOW.

4964. Natural Breakdown of Single Crystals of Zinc Phosphide. V. Antonov-Romanovskij. *Comptes Rendus de l'Acad. des Sciences, U.R.S.S.* 3. *pp.* 432–435, *Aug.* 21, 1934. *In German.*—The breakdown of 4 crystalline specimens of zinc phosphide is measured as a function of the crystal size, the temperature and the intensity of the exciting light. For the largest crystals (of size about 100 μ) agreement is found with a formula derived by Wawilow for bimolecular reactions but for smaller crystals (down to 10 μ in size) a simple hyperbolic expression gives approximately accurate results. H. J. H. S.

4965. Line Emission and Absorption of Chromium Phosphors. O. Deutschbein. *Ann. d. Physik,* 20. 8. *pp.* 828–842, *Sept.*, 1934.—The author has been able to extend previous work using temperatures down to 14° Abs. with liquid hydrogen [see Abstracts 4958 (1932) and 1064 (1933)]. It is found that the sharpness of the principal and subsidary lines is not measurably affected by a lowering of the temperature from 78° K. to 20° K. This is considered to be due to the fact that the lattice vibrations are already effectively suppressed at 78° K. On the other hand the relative intensity of the principal line R_2 with respect to the longer wave line R_1 is altered by temperature in accordance with the formula $R_2/R_1 = e^{-h \cdot \Delta\nu/KT}$. This is taken to indicate that the longer wave line is directly excited, but that the shorter wave line is only indirectly excited through thermal energy. The intensity changes of the various lines enables a more exact term scheme than formerly to be deduced. In a magnetic field the principal lines and the subsidiary lines are split up —the components of the principal being more numerous than those of the subsidiary. From the latter fact it is concluded that the principal lines are more degenerate than the subsidiary. J. E.

4966. Fluorescence of Cadmium Vapour. J. Swietoslawski. *Zeits. f. Physik,* 91. 5–6. *pp.* 354–360, *Oct.* 5, 1934.—The dependence of the character of the van der Lingen bands of Cd vapour fluorescence on the nature of the exciting light has been studied. The vapour was excited by sparks from Ag, Fe, Zn, Mg, Mu and Cr. It is found that (*a*) the long-wave limit and the first fluctuation maxima are dependent on the wave-length of the exciting light being shifted towards *shorter* waves with *increasing* wave-length of exciting light ; (*b*) the rate of fading away of the maxima depends also on the kind of excitation, increasing with increasing wave-length of excitation. J. E.

4967. Magnetic Extinction of the Fluorescence of Diatomic Selenium Molecules. J. Genard. *Comptes Rendus*, **199.** *p.* 784. *Oct.* 22, 1934.—A preliminary visual examination of the photometric plates shows that the fluorescence of selenium, excited by the λ 4047 and λ 4359 lines of mercury is weakened by about 40 or 50 % by a field of 43,000 gauss, the series excited by the former line being the more markedly weakened. The various terms of the same series of fluorescence lines are affected to different extents, and the lowest frequency component of the rotation doublets is weakened to a greater extent than the component of high frequency. [See also Abstracts 2445 and 4148 (1934).]

N. M. B.

See also Abstracts 4989, 5034, 5035, 5036, 5092, 5093.

INTERFERENCE. DIFFRACTION AND SCATTERING.

4968. Statistical Structure of the Interference-Field. E. Brumberg and S. Wawilow. *Comptes Rendus de l'Acad. des Sciences, U.R.S.S.* **3.** *pp.* 321–328, *Aug.* 11, 1934. *In German.*—A visual method is described for measuring the variations in the coherence of the beams over an interference-field. G. C. McV.

4969. Origin of the Colours in the Plumage of Birds. C. V. Raman. *Indian Acad. Sci., Proc.* **1***A. pp.* 1–7, *July*, 1934.—Observations are described with the feathers of *Coracias Indica* which throw doubt on the correctness of the theory that the blue of these feathers is a simple Tyndall effect due to the scattering of light by minute air cavities within the substance of the barb. Observations with the " Ultra-opak " microscope show that the coloured layers may exhibit tints ranging over the whole spectrum. A simple Tyndall effect is thus definitely insufficient to explain the observed phenomena. Further studies indicate that the cavities responsible for the colours are extended structures. The two alternative possibilities, namely, diffraction by cavities not small compared with the wave-length and interferences from the surfaces of minute films, are considered and discussed, without a final decision being reached.

AUTHOR.

4970. Generalisation of the Michelson Experiment. L. Baumgardt. *Zeits. f. Physik*, **91.** 11–12. *p.* 819, *Oct.* 23, 1934.—A correction. [See Abstract 4152 (1934).]

4971. Quantum Effects in the Scattering of Light. K. W. F. Kohlrausch. *Die Physik*, **2.** 4. *pp.* 177–190, 1934.—This short review covers (1) the Compton effect, (2) the absorption and scattering of X-rays and γ-rays, and (3) the Raman effect. The more important theoretical and experimental publications are mentioned, references being to the corresponding abstracts in the *Physikalische Berichte*. L. A. W.

4972. Longitudinal Light Scattering in Liquids. R. S. Krishnan. *Indian Acad. Sci., Proc.* **1***A. pp.* 44–47, *July*, 1934.—Experiments on the " Plotnikow " effect or the longitudinal light scattering in liquids [see Abstract 3419 (1931)] were carried out with liquids not free from dust and also with liquids free from dust. The effect was observed conspicuously in the case of dusty liquids. The effect completely disappeared in the liquids so far examined when they were freed from dust by repeated distillation *in vacuo*. It thus seems clear that the Plotnikow effect is not a molecular phenomenon but is due to the presence of dust. AUTHOR.

4973. Scattering of Light by Liquid Surfaces. S. Jagannathan. *Indian Acad. Sci., Proc.* 1*A*. *pp.* 115–119, *Aug.*, 1934.—A clean mercury surface is obtained by scraping with the edge of a metal sheet. Unpolarised light is incident normally in the surface, and the light scattered at grazing incidence is found to be polarised, with the electric vector normal to the surface. The Mandelstam-Gans theory of light-scattering by liquid surfaces is criticised. A. C. M.

4974. Scattering of Light by Particles Suspended in a Medium of Higher Refractive Index. R. S. Krishnan. *Indian Acad. Sci., Proc.* 1*A*. *pp.* 147–155, *Sept.*, 1934.—A calculation of the intensity and polarisation of the light scattered by air-bubbles of various sizes suspended in liquids of different refractive indices. The calculation was based on the formula derived by Mie, and results are obtained for three different values of refractive indices and three different sizes of particles. When the particles are small, the intensity is distributed symmetrically about the plane perpendicular to the beam. As the size of particle increases, the intensity of the forward scattering exceeds that of the backward scattering. The angle of maximum polarisation is displaced from 90° backwards, and is nowhere complete. As an experimental confirmation, an emulsion of water drops in benzene was observed, and the forward scattering was judged by eye to be greater than the backward scattering. A. C. M.

4975. Critical Opalescence of Binary Mixtures. A. Rousset. *Comptes Rendus*, 199. *pp.* 716–718, *Oct.* 15, 1934.—The variation of the intensity of scattered light with wave-length, taking particular account of the effects of absorption, is measured for a number of binary mixtures at temperatures just below the critical point of complete miscibility. For water : triethylamine, and hexane : nitrobenzene mixtures, the intensity varies with λ^{-4}. It is also distributed symmetrically about a scattering angle $= \pi/2$. For water : isobutyric acid, and aniline : cyclohexane, the variation is again as λ^{-4} so long as the temperature is more than 0·15° from the critical temperature, but nearer than this to the critical point, the intensity varies with λ^{-n} where n itself decreases progressively from 4. These two mixtures exhibit a dissymmetrical distribution of scattered intensity, and their behaviour is in accordance with the theory of Rocard. None of the solutions conforms with the theory of Ornstein and Zernicke. **Erratum,** *ibid. p.* 812, *Oct.* 22, 1934. C. B. A.

See also Abstracts 4797, 5115, 5152.

PHOTOCHEMISTRY (INCLUDING PHOTOGRAPHY).

4976. Budde Effect in Halogens. T. S. Narayana. *Indian. Journ. Phys.* 9. *pp.* 91–109, *Sept.*, 1934.—Experiments on the Budde effect in halogens Cl_2 and Br_2 were made under varied conditions. Budde effect was found absent in dry gases. Experiments were made on pure dry Cl_2 enclosed in a pyrex bulb where all heat losses from the glass walls were arrested; and photo-expansion was observed. Dry air + dry halogen mixtures showed expansion on illumination. The Budde effect was

absent in the band absorption region. All the existing theories are reviewed and discussed. A mechanism based on the theory put forward by Born and Franck for the formation of a homopolar diatomic molecule is given and the divergent results of the various workers are reconciled.
AUTHOR.

4977. Photoreactions of Ketones. Part I. E. J. Bowen and E. L. A. E. de la Praudière. Part II. E. J. Bowen and A. T. Horton. *Chem. Soc., J. pp.* 1503–1506, *Oct.*, 1934.—In Part I the photoreactions of acetone and of benzophenone have been investigated in solution and in the pure liquid state. No gaseous products are liberated, and the reaction is much faster in the former than in the latter state. These results are explained on the hypotheses that the primary excited level of the ketone is non-reactive, and capable of deactivation on collision, and can pass into a second reactive level (which does not dissociate instantly) after a time of the order of 10^{-12} sec. The arrangement of light sources, filters and methods of measuring the light absorptions of the liquids have already been described [see Abstract 4893 (1932)]. In Part II the photopolymerisation of diacetyl in solution in light of wave-lengths 4360–3660 Å has been investigated. The quantum efficiency is greater in more dilute solutions. An explanation based on the existence of two excited levels and on deactivation by normal molecules of diacetyl has been given. AUTHORS.

4978. Photodecomposition of Formic Acid Vapour. E. Gorin and H. S. Taylor. *Am. Chem. Soc., J.* 56. *pp.* 2042–2047, *Oct.*, 1934.—The products of photodecomposition of single formic acid molecules are carbon monoxide and water and carbon dioxide and hydrogen. The two former predominate at longer wave-lengths of illumination. The ratio is displaced toward the latter products with increase of temperature and increase of light frequency. The products of photodecomposition of double formic acid molecules are exclusively carbon dioxide and hydrogen in the whole wave-length region from 1900 to 2540 Å. The decompositions of the two species of molecule are independent, and the quantum yield is unity for each species, independent of temperature and pressure over considerable ranges. The ultra-violet absorption spectrum of the double molecule is continuous; that of the single molecule is banded and of the predissociation type. The primary process of absorption leads to decomposition to form saturated molecules, with minimal formation of hydrogen atoms and radicals. AUTHORS.

4979. Chemical Action of Light on Di-iodo-hydrocarbons. G. Emschwiller. *Comptes Rendus*, 199. *pp.* 854–856, *Oct.* 29, 1934.—The tendencies of H and I to split off together in the photolysis of CH_2CI_2 and of 2I to do so in that of $(CHI)_2$ are also displayed by CH_3CHI_2 and $(CH_2I)_2$ respectively, the decomposition of CH_3CHI_2 being according to: CH_3CHI_2 + light = $CH_2{:}CHI + (H,I)$, and $CH_3CHI_2 + (H,I) = CH_3CH_2I + I_2$, both products then decomposing with separation of I_2, so that finally $4CH_3CHI_2 = C_2H_2 + 2C_2H_4 + C_2H_6 + 4I_2$, the C_2H_4 then mostly forming $C_2H_4I_2$. Further while $(CHI)_2$ and $(CH_2I)_2$ do not react with O under the influence of ultra-violet light CH_3CHI_2, like $CH_2{:}CI_2$ is completely oxidised. The analogy of structure between CH_2I_2 and CH_3CHI_2 implied by similarity of decomposition is confirmed by similarity of absorption spectra, and the rapid photochemical oxidation of CH_2I_2. The much greater (× 100) photochemical stability (in absence of O) of CH_2I_2 as compared with that of CH_3CHI_2 seems to be due to the presence of but one C in the molecule. Similarly the stability of CH_3I is three times that of

C_2H_5I, while CHI_3 is also very stable as regards light in absence of O. [See Abstract 2856 (1931).] C. A. S.

4980. Photochemical Retardation. M. Trautz and H. E. Haas. *Zeits. f. wiss. Phot.* 33. *pp.* 129–144, *Oct.*, 1934.—A number of cases recorded of retardation of chemical reactions by irradiation have been subjected to critical examination, no confirmation of such retardation being obtainable except in the two following instances: (1) Auto-oxidation of sodium sulphide solution. Red light definitely accelerates this, but with violet light a slight retardation was observed in most of the tests. This case still remains somewhat doubtful. (2) Auto-oxidation of benzaldehyde, which is greatly accelerated by blue light, but delayed by long-wave light. As a water filter annuls the retarding effect, this is an infra-red effect, but it is uncertain how far it is to be associated with the well-known annulling action of the infra-red or attributed to chemical influences or to thermal layering or shadow effects resulting from infra-red absorption. Retardation of a two-phase auto-oxidative reaction of a chemically definite, single substance in long-wave light is, however, now established for the first time. T. H. P.

4981. Inert Gas Effects in the Photosynthesis of Hydrogen Bromide. M. Ritchie. *Roy. Soc., Proc.* 146*A*. *pp.* 828–848, *Oct.* 15, 1934. —Investigation has been made of the rates of photochemical formation of HBr at 200° C. in the presence of various "foreign" gases, from two points of view (*a*) the removal of Br atoms from the gas phase by diffusion to the wall of the reaction vessel, and (*b*) the removal of Br atoms by the recombination process involving a third molecule as stabiliser. In (*a*), addition of foreign gas is accompanied by increase in the rate of reaction, the relative accelerations corresponding to those calculated on kinetic theory considerations and being expressed by the series $CCl_4 > CO_2 > N_2, O_2 > A > H_2$ and He. In (*b*), addition of foreign gas decreases the rate of reaction by facilitating the recombination of Br atoms. The series representing the efficiencies of the triple collision process is given by $CO_2 > O_2 > N_2 > A > He > H_2$. Attention is drawn to the parallelism existing between this series and that of the corresponding accommodation coefficients as determined from thermal conductivity measurements. AUTHOR.

4982. Induction Period of the Photochemical Reaction between Hydrogen and Chlorine. J. G. A. Griffiths and R. G. W. Norrish. *Roy. Soc., Proc.* 147*A*. *pp.* 140–151, *Nov.* 1, 1934.—During the induction period of the photochemical H_2–Cl_2 reaction, due to NCl_3 produced by interaction of dry NH_3 and Cl_2, NCl_3 is decomposed photosensitively by the Cl_2 in a zero-order reaction. In the absence of water, NH_4Cl does not cause an induction period since it does not react with Cl_2. The quantum efficiency of the decomposition is given by $\gamma = 2\cdot5 + 1/(0\cdot0038\ P_{Cl_2} + 0\cdot0009\ P_{H_2})$. Hence, H_2 behaves like the "inert" gases already studied in shortening the chain length of the photosensitised decomposition of NCl_3. It is therefore inferred that the induction period is increased by added gases. During the period of inhibition, which persists until all the NCl_3 is decomposed, the yield of HCl is less than 0·2 mol. per quantum absorbed as compared with yields of the order of 1500 mol. obtained with mixtures of pure H_2 and Cl_2. It is calculated that approximately every collision between a Cl atom and a NCl_3 molecule renders the Cl incapable of taking part in the propagation of H–Cl chains. Since the mechanism of the decomposition of the inhibitor involves Cl atoms, it is concluded that only Cl atoms in the $^2P_{\frac{1}{2}}$ or some other specially activated state, lead to the synthesis of HCl, as suggested by Rollefson, whereas atoms in this special state of activation are not preserved in the NCl_3 reaction chain.

H. H. Ho.

4983. Photochemical Reaction of Oxygen with Hydrogen in the Schumann Region. H. Neujmin and B. Popov. *Zeits. f. phys. Chem.* 27. *Abt.B.* 1–2. *pp.* 15–27, 1934.—By optical dissociation of O_2 molecules in the region 1750–1350 Å, O atoms in the normal (^3P) and metastable (^1D) states have been produced. Manometric investigation of the reactions of these atoms with H_2 at a pressure of about 0·1 mm. shows that the metastable atoms are far more reactive than the normal ones.

T. H. P.

4984. Comparison of Photosensitised Reaction of Hyrogen and Oxygen, and Deuterium and Oxygen. M. G. Evans. *J. Chem. Phys.* 2. *pp.* 726–732, *Nov.*, 1934.—The rates at which hydrogen-oxygen and deuterium-oxygen mixtures react when illuminated in the presence of mercury vapour, have been measured. There is found to be very little difference between the rates under these conditions and the temperature coefficients of the two reactions are, to within the accuracy of this work, equal. Various mechanisms are discussed in the light of this experimental observation. AUTHOR.

4985. Photosensitised Decomposition of Ammonia and Deutero-ammonia. M. G. Evans and H. S. Taylor. *J. Chem. Phys.* 2. *pp.* 732–734, *Nov.*, 1934.—A kinetic expression for mercury-sensitised NH_3 and ND_3 decompositions which represents the experimental data is developed empirically and an explanation of the expression in terms of the various kinetic processes is sought. This expression is further modified to include the intrinsic decomposition probability of the ammonia or deuteroammonia molecule. The final expression is able to express the results quantitatively, and yields values for the quenching ratio, $k_{1NH3} : k_{1ND3} = 4 : 1$ and a decomposition probability after quenching $\phi_{NH3} : \phi_{ND3} = 5 : 1$. AUTHORS.

4986. Photochemical Oxidation of Phosphine above the Upper Explosion Limit. H. W. Melville and H. L. Roxburgh. *J. Chem. Phys.* 2. *pp.* 739–752, *Nov.*, 1934.—The results are summarised by the equations: Hg-sensitised reaction $-d[PH_3]/dt = \text{const.}\ [PH_3]/[O_2]^2$ intensity, Direct photo-reaction $-d[PH_3]/dt = \text{const.}\ [PH_3]^2/[O_2]^2$. The reactions are shown to be of the chain type and inhibited by O_2. On the basis of previous knowledge of the propagation of the chains, the question of termination was examined and it is shown that out of six possible cases, only one is in agreement with the facts. This is that the chain carrier, which normally reacts with PH_3, is destroyed in a ternary collision with two O_2 molecules or with one O_2 and one N_2 molecule (or an A atom). The efficiency of the collision is about 0·5. In view of these results, it is highly probable that this carrier is an oxygen atom. In the photosensitised reaction one-fifth of the collisions between O_2 molecules and excited Hg atoms results in the initiation of a chain. These results are shown to be quantitatively consistent with the shape and also the position of the upper limiting explosion curve, except that the limiting pressure is a little higher than that calculated by a strict application of the theory of branched chains. The upper limit is displaced to higher pressures by illumination of the mixture, a phenomenon not predicted by theory. The effect is of short duration, < 2 sec. and it is not exhibited at the lower limit. The significance of this result is discussed in relation to the theory of the reaction.

AUTHORS.

4987. Radiation Quanta and Photographic Threshold Value. H. Broili, R. Glocker and H. Langendorff. *Zeits. f. Elektrochem.* 40. *pp.* 784–789, *Nov.*, 1934.—Grain-number curves obtained with Agfa contrast emulsion for various wave-lengths, by counting the grains developed and those originally present, are considered in the light of the theory of probabilities. It is found that the number of absorption-acts per granule diminishes in indirect proportion to the magnitude of the radiation quantum. Thus, to render a granule of AgBr developable with the wave-length 546 $m\mu$, two quanta are necessary, their absorption to take place within a definite, ray-sensitive region of the granule. The ray-sensitive volume of a granule is determined to be equal to the volume of a monatomic surface-layer of the granule. T. H. P.

4988. Action of Various Elements and Compounds on the Photographic Plate. S. Aoyama, T. Fukuroi and I. Takahashi. *Tôhoku Univ. Sci. Reports,* 23. *pp.* 384–404, *Aug.,* 1934. *In English. Report No.* 327 *of the Research Inst. for Iron, Steel and other Metals.*—A study is made of the blackening produced when various metals are placed on photographic plates, and of the variation of the effect with time of exposure, temperature, nature of gas surrounding the specimen, etc. The existing theories are discussed in the light of the present results and a theory is put forward suggesting that the effects are due to the gas surrounding the substance being activated and thus being able to affect the photographic emulsion. A. H.

See also Abstracts 4795, 4823, 4824, 4825, 4904, 5011, 5056, 5259.

PHOTOMETRY.

4989. Accuracy of Photometric Extinction Methods. E. Brumberg and S. Wawilow. *Comptes Rendus de l.Acad. des Sciences. U.R.S.S.* 3. *pp.* 405–411, *Aug.* 21, 1934. *In German.*—The limit of accuracy of visual extinction methods is determined by the capabilities of the dark-adapted eye, which possesses a high sensitivity. In the green part of the spectrum 50–100 photons are sufficient to excite the visual response. This limit is beyond that of the ordinary photoelectric cell and in a photographic method it would require several hours' exposure. An apparatus is described for testing the accuracy of the visual method and a series of results for two observers is given. The fluorescence of an aqueous solution of fluorescein, excited by a 5-ampere carbon arc lamp, is measurable when the concentration of the fluorescein is about 10^{-13} gm. per cc.

H. J. H. S.

4990. Bridge Circuit for Regulation of Constant-Current Photometer Lamps. R. Sewig. *Zeits. f. techn. Physik,* 15. 10. *pp.* 384–385, 1934.—Briefly describes two bridge circuits suitable for d.c. and a.c., three arms of which are fixed resistances, the fourth being the photometer lamp which is to be run at constant current. The action of the circuits depends upon the temperature-resistance relationship of the lamp, and the circuits are suitable for both tungsten-filament and carbon-filament lamps. A null galvanometer is used as an indicator for the d.c. bridge, and a pair of headphones in the a.c. case. R. C. F.

See also Abstract 4958.

POLARISATION.

4991. Use of Simple Compensators in the Analysis of Elliptical Vibrations. G. Bruhat and P. Grivet. *Comptes Rendus,* 199. *pp.* 718–720, *Oct.* 15, 1934.—A description is given of a series of simple mica plate compensators for use in photoelectric polarimetry at various visible and ultra-violet wave-lengths. C. B. A.

4992. Photoelectric Analysis of Elliptical Vibrations. G. Bruhat and P. Grivet. *Comptes Rendus,* 199. *pp.* 852–854, *Oct.* 29, 1934.—The photoelectric methods of polarimetry can be used, with the help of a two-field analyser, to analyse any elliptical vibration. The precision obtainable is comparable with that of visual methods, and the photoelectric methods are in some respects simpler, since they make use of larger half-shadow angles. C. B. A.

*See also A*bstracts **4822, 4826, 4961, 4973, 5030.**

RADIATION, EMISSION.

4993. Separation of Monochromatic Rays from the White Radiation of the Mass Radiator. A. Glagoleva-Arkadjeva. *Comptes Rendus de l'Acad. des Sciences, U.R.S.S.* 3. *pp.* 415–418, *Aug.* 21, 1934. *In German.*—The radiation of the mass radiator [see Abstract 156 (1930)] includes a very large gap in the spectrum of the electromagnetic waves—at least from 50 mm. to 0·08 mm. The radiator possesses a white radiation and a first requirement is a separation of the radiation of a definite wave-length. For monochromatisation of rays the method of the stepped grating has been used. The method of the reflecting step grating permits the strengthening of the energy of a definite wave-length for which the condition $\lambda = 2\,d \cos i$ is fulfilled, where λ = wave-length, d = height of the grating step, and i = the angle of incidence of the ray on the grating step. Thus for every definite value of i a definite wave-length corresponds, and by the grating waves of different length can be separated in a determined interval. For the measurement of the length of the waves separated by the step-grating the interferometer with Boltzmann mirrors was used. The wave energy was measured with a thermo-element connected with a galvanometer of sensitivity 10^{-10} ampere. In order to free the radiation of the mass radiator from the strong long waves a wire network with meshes of 1 cm.^{2} was placed in the path of the rays to the step grating. J. J. S.

4994. Quasi-Chemical Actions of Hertzian Waves and their Application. W. Arkadiew. *Comptes Rendus de l'Acad. des Sciences, U.R.S.S.* 3. *pp.* 413–414, *Aug.* 21, 1934. *In German.*—When metals coated with oxide, etc., are brought into contact, friction and pressure are required to break down the oxide, etc., in order that metallic contact may result. Under an adequate pressure, this is facilitated by the passage of a current of sufficiently high voltage to pierce the separating layer. This action was used by Branly (1890) to study the electric vibrations caused by Hertzian waves in conductors. The phenomenon may serve for the detection of electric vibrations in the following manner. If a copper and a zinc sphere (or a Branly tube) are laid on paper soaked with neutral salt and phenolphthalein solution and contact between the copper and zinc is induced by the action of electric waves, the couple acts as a voltaic element. Alkali separates under the copper and the paper becomes red. With a number of such detectors laid on the paper, this turns red wherever the waves impinge. The apparatus is simple and portable, no galvanometer or conductors being required; it may be placed in a balloon for investigating Hertzian waves in the stratosphere. The method is applicable to long waves and to short radio-waves. The use of electric waves to accelerate chemical processes in mixtures containing metallic turnings or filings, especially of dissimilar metals, may prove of interest. [See following Abstract.] T. H. P.

4995. Diffraction of Electric Waves Registered Chemically. W. Arkadiew. *Comptes Rendus*, 199. *pp.* 848–849, *Oct.* 29, 1934. *Zeits. f. Physik*, 92. 3–4. *pp.* 194–203, *Nov.* 12, 1934.—The passage of electric waves is shown by a detector based upon the principle of Branly's coherer [see preceding Abstract]. Figures are given of the positions of the discolorations when the waves have passed through a grating with openings parallel to the electric vector, and when diffraction occurs due to a rod placed in the path of the waves. From the first figure the wave-length is calculated. H. M. B.

4996. Influence of Magnetic Perturbations on the Velocity of Long Electromagnetic Waves. N. Stoyko. *Comptes Rendus*, 199. *pp.* 845–847, *Oct.* 29, 1934.—Velocities of waves during (*a*) severe magnetic storms, (*b*) slight disturbances, (*c*) calm periods at different times of the year are taken from the International Bureau des Heures from 1929–1932 and tabulated. During storms the velocity of the waves is found to increase, and as the difference is greater, the greater is the magnetic perturbation. This magnetic agitation is produced by particles from the sun and in consequence the Heaviside layer is lowered and reflections of the electromagnetic waves occur at a lower altitude, so the apparent velocity is increased. 14,000 receptions at different stations of long waves are used to obtain the results. H. M. B.

4997. Measurement of Ionospheric Heights at Calcutta during the Polar Year 1932–1933. H. Rakshit. *Phil. Mag.* 18. *pp.* 675–696, *Oct.*, 1934.—Measurements were made at Calcutta of ionospheric heights, using the group-retardation method and a wave-length of 75 m. The results obtained during 1932–33 are here summarised and discussed. The results show that the height of both the E- and F-layers generally reaches a minimum value about mid-day. The height is a maximum about 20 or 30 min. before ground sunrise and then falls abruptly to the normal day-time value within about an hour after ground sunrise. On an average, the height of either layer is greater in winter than in summer and the noon-time ionisation of either layer is greater in summer than in winter. Echoes from the F-layer are frequently found at night to be split up into a large number of components, due to the influence of the earth's magnetic field. Immediately after the appearance of such splitting the echoes are found to disappear completely. A possible explanation of this effect is given. The observations also indicate the existence of a steeper gradient of ionisation density in the E-layer than in the F-layer. The gradient was found to diminish with increase of height. A. W.

4998. General Properties of Formulæ of the Magneto-Ionic Theory. H. G. Booker. *Roy. Soc., Proc.* 147*A*. *pp.* 352–382, *Nov.* 15, 1934.—A discussion is given of some general features of the magneto-ionic theory which appear when collisional friction is taken into account and incidence is not necessarily vertical. The nature of the transition from longitudinal to transverse propagation is described. It is shown that, at the height where $N = mp^2/4\pi(1 - l)e^2$, the direction of rotation in the polarisation ellipse of a magneto-ionic component does or does not reverse according as $\nu \gtreqless \frac{1}{2}\frac{\sin^2\theta}{|\cos\theta|}p_H$ at this height, and that in the intermediate case the component resplits. Curves are drawn showing the general nature of the variation of μ and ck/p with height at vertical incidence when there is a small constant value of friction and the Lorentz polarisation term is neglected. When incidence is oblique the magneto-ionic components follow different paths, and it is shown that the names " ordinary " and " extraordinary " are in general unsuitable. Although the directions of rotation in the polarisation ellipses of the magneto-ionic components are necessarily opposite at the transmitter they may be the same at the receiver. Reversal of direction of rotation can only take place at the height already mentioned or at a height where propagation is transverse to the earth's magnetic field. AUTHOR.

4999. Automatic Registration of the Amplitude of Downcoming Wireless Waves. F. W. G. White. *Phys. Soc., Proc.* 46. *pp.* 805–817, *Nov.* 1, 1934.—An adaptation of the Breit and Tuve method of echo delineation, by means of which it is possible to obtain a continuous record of the amplitude of the wireless waves reflected from the ionised regions of the earth's atmosphere, is described. An optical system is used to separate the records made on the photographic paper by the first and second reflections. Attention is directed to the different types of signal fluctuations that may occur. Examples of an interference phenomenon between the two magneto-ionic components of the downcoming waves are described. The reflection coefficient of the ionised regions is discussed and a rapid method of finding the relationship between this coefficient and the frequency of the waves is described. AUTHOR.

5000. Self-Synchronised System for Ionospheric Investigation by the Pulse Method. O. O. Pulley. *Phys. Soc., Proc.* 46. *pp.* 853–871, *Nov.* 1, 1934.—The paper describes an arrangement for the convenient study of the ionosphere by the pulse method when the sending and receiving stations are of necessity in different locations having no interconnection (*e.g.*, no common mains supply) to provide a synchronising frequency. Even under conditions of considerable electrical interference, the system provides (*a*) an extremely steady pattern of layer-height and echo-intensity on the kathode-ray oscillograph screen, suitable for visual observation or for photographic snapshot records ; (*b*) immediate photographic delineation of a curve showing the variation of layer-height with frequency ; and (*c*) continuous records of the variation of layer-height with time. It has the advantage that local disturbances connected with the mains supply do not produce a stationary pattern on the screen, as is the case when the pulse-recurrence frequency is the same as that of the mains supply at the receiver. A very simple and positive method of modulating a pulse transmitter, which uses a thyratron alone without the usual amplifying or auxiliary control valves is described. A further innovation is that the calibration of the time-base or scale of equivalent height is impressed permanently on the record, thus providing a continuous check of scale value, and facilitating the interpretation of the records. AUTHOR.

5001. Deep-Water Measurements of Cosmic Rays in the North Sea. J. Clay, J. T. Wiersma and C. G. 't Hooft. *Physica,* 1. *pp.* 1077–1081, *Oct.–Nov.*, 1934. *In English.*—In the North Sea, measurements with an ionisation chamber were made down to a depth of 200 m.

The results are in close agreement with those obtained previously in the Gulf of Aden. In addition to this, measurements with four counters were carried out under 25 and 50 m. of water. With open chamber, there is only very little variation of ionisation intensity at sea level, for magnetic latitudes higher than 58°. On the Norwegian coast, the irregularity found by Corlin was confirmed as far as the authors' routes coincided. AUTHORS.

5002. Analysis of Cosmic Rays at High Altitudes. P. Auger and L. Leprince-Ringuet. *Comptes Rendus*, 199. *pp.* 785–787, *Oct.* 22, 1934.—Experiments are continued [see Abstract 175 (1934)] on the Jungfraujoch with triple coincidence counters, collinear and non-collinear, on the surface and 4 m. deep in the glacier (equal to the 3500 m. altitude of the glacier), and with lead screens present and absent. The softer components of the cosmic radiation, which constitute the showers, show absorption but the primary corpuscles of great penetrating power are little affected. It is concluded that the two components are independent and that the showers are produced by some other radiation, possibly of a γ-ray type. F. C. C.

5003. High-Altitude Measurements and Interpretation of Cosmic Ray Phenomena. I. S. Bowen, R. A. Millikan and H. V. Neher. *Phys. Rev.* 46. *pp.* 641–652, *Oct.* 15, 1934.—The results obtained in aeroplane flights up to 22,000 ft. at various latitudes and in stratosphere flights up to 60,000 ft. are interpreted in the light of the Epstein and Lemaître-Vallarta analysis of the effect of the earth's magnetic field, and of the Bowen-Millikan proof that the ionisation of the atmosphere is due immediately to electrons (+ and −). A number of conclusions are reached, the following being the most outstanding: that at and below sea-level most of the ionisation is produced by photons of energy $200 \pm 170 \times 10^6$ V; that at the equator a small part of the ionisation is due to incoming secondary electrons of energies up to 10^{10} V, which are responsible for the east-west effect and the longitude effect found in the equatorial belt; and that it is possible to attribute the radiation only to atom-annihilations, partial and complete, which processes are facilitated by the opposite extremes of temperature found in interstellar space and in novæ. D. H. F.

5004. Coincidence Test of the Corpuscular Hypothesis of Cosmic Rays. D. S. Hsiung. *Phys. Rev.* 46. *pp.* 653–658, *Oct.* 15, 1934.—Three Geiger-Müller counters were arranged vertically, double and triple coincidences between 1 and 2, and 1, 2 and 3 being recorded respectively. The third counter was permanently shielded by a Pb cylinder 2·5 cm. thick; counts were made (*a*) without further absorber, (*b*) with 20 cm. of Pb between 1 and 2, (*c*) with 20 cm. of Pb above 1. The results may be interpreted as due to penetrating ionising particles and not to secondary particles produced by photons which traverse the Pb. The view is supported by the close agreement of the absorption coefficients computed from this experiment with those determined by ionisation experiments. F. C. C.

5005. Measurements of the Corpuscular Penetrating Radiation with the Tube Counter. H. Maass. *Phys. Zeits.* 35. *pp.* 858–861, *Nov.* 1, 1934.—Coincidences due to penetrating radiation were investigated with two counters used in conjunction with an Fe absorber, of which the thickness could be increased to 18 cm., placed alternately above and between the counters. The average statistical error was 1·9 %. The yield was always greater with the absorber above the counters and the difference, which increased uniformly above 8 cm. of Fe, was attributed to the existence of a photon component of the penetrating radiation.

F. C. C.

See also Abstracts 5073, 5197.

RADIATION, GENERAL THEORY.

See Abstracts 4871, 4875, 5010.

REFLECTION. REFRACTION AND DISPERSION.

5006. Optical Constants of Thin Metal Films in the Long-Wave Infra-Red. W. Woltersdorff. *Zeits. f. Physik,* 91. 3–4. *pp.* 230–252, *Oct.* 2. 1934.—The reflecting power of thin metal films is investigated over the wave-length range 25–100 μ, in order to find whether the Maxwell theory is confirmed by experiment as it is in the case of transmission [see Abstract 2997 (1929)]. The theory is found to be confirmed in so far as the investigations are made with metals with particularly good conductivity (Ag, Al, Au), and the film thicknesses are greater than certain limits depending on the metal used. Deviations from theory fall into two groups, *viz.*, anomaly of " thinnest films " and anomaly of " bad conductors," and an attempt is made to explain them with reference to a dielectric constant of the metals. Values of 500–1000 are indicated for this constant. Opaque Al and Sn films form good mirrors through the whole infra-red spectrum. C. B. A.

5007. Reflectivity of Copper, Silver and Gold. Y. Fujioka and T. Wada. *Inst. Phys. and Chem. Research, Tokyo, Sci. Papers, No.* 525, *pp.* 1–19, *Oct.,* 1934. *In English.*—The reflectivities of Ag, Cu and Au are measured at 0° C., 100° C., and – 180° C. The reflectivity of Ag is calculated for these temperatures on the basis of the dispersion theory and satisfactory agreement is obtained. J. T.

5008. New Invariant Applicable to Two Light Pencils Having the Same Mean Ray. P. Copel. *Rev. d'Optique,* 13. *pp.* 193–198, *June–July,* 1934.—It is shown that for two pencils with a common mean ray, the product $n^2C_t dSdS_1$ has the same value at all points P on the mean ray, where n is the refractive index of the medium at P, dS and dS_1 are the areas intercepted by the two means in the plane normal to the mean ray at P, and C_t is the specific curvature of a surface derived by a simple geometric construction from the wave surfaces of the two pencils at P. The invariance remains valid in passing from one medium to another, and reduces to the Lagrange-Helmholtz formula and Straubel's equation in certain cases. W. S. S.

5009. Duality Principle in Optics. M. Herzberger. *Zeits. f. Physik,* 91. 5–6. *pp.* 323–328, *Oct.* 5, 1934.—The author considers a fundamental law in optics which facilitates especially the investigation of the image of an infinitely distant plane by consideration of a finite problem. By a simple transformation principle this method can be applied to a dual development for each law of optics. The ideas are applied to Gaussian optics and can be used for objects having flat or curved surfaces.

R. S. R.

5010. Huygen's Principle Applied to Cylinder Waves. J. Picht. *Zeits. f. Physik,* 91. 11–12. *pp.* 717–723, *Oct.* 23, 1934.—It is shown that Huygen's principle in a modified form can be applied to cylinder waves, *i.e.*, that it is allowable to consider the cylindrical wave surfaces to be divided into strips of differential width parallel to the axis of the cylinder, and to take these strips as linear sources of light which on their part send out elementary cylinder waves. J. J. S.

5011. Image-Distortion Due to Glass-Thickness in Lens Systems. Part II. H. D. Taylor. *Phys. Soc., Proc.* 46. *pp.* 889–896, *Nov.* 1, 1934.—The simplest method of applying the formulæ given in Part I [see Abstract 1144 (1934)] is discussed. The formulæ are applied to a Series V Cooke lens of 10-in. equivalent focal length. The effects of the three axial-glass thicknesses in producing fractional distortion in the final image or focal plane are ascertained by the application of two alternative but mutually confirming methods, the older and simpler of which is recommended for adoption. AUTHOR.

5012. Refractivity of Liquid Mixtures. G. Narasimhiah. *Indian Acad. Sci., Proc.* 1*A*. *pp.* 34–38, *July*, 1934.—The Raman-Krishnan theory of the optical and electrical properties of liquids based on the idea of an anisotropic polarisation field is extended to the case of binary liquid mixtures. The average moments induced in a type-A and a type-B molecule in the liquid mixture by unit incident field are calculated separately and summed up giving them weights corresponding to the concentration of the liquid mixture. The formula obtained has been verified in the cases of acetone-water and methyl alcohol-water mixtures.

AUTHOR.

5013. Optical Constants of Alkali Halide Crystals. A. Kublitzky. *Ann. d. Physik*, 20. 7. *pp.* 793–808, *Sept.*, 1934.—In continuation of the work of Hilsch, Pohl and Bauer on the optical properties of alkali halide crystals [see Abstract 2040 (1934)], the refractive dispersions of crystalline KF, NaF, RbBr, and RbI over a wide range of visible and ultra-violet wave-lengths are recorded by the minimum-deviation method employing prisms made from artificially-prepared crystals. Absolute values of the absorption constants for the first ultra-violet bands of RbBr and RbI have also been measured by the method of Bauer.

C. B. A.

5014. Molecular Refraction of Argon, Krypton and Xenon. G. Damköhler. *Zeits. f. phys. Chem.* 27. *Abt.B.* 1–2. *pp.* 130–144, 1934.—Absolute values for the molecular refractions of A, Kr and Xe at 5461 and 6563 Å have been determined interferometrically to a high precision. The results for A agree with the values recorded by Cuthbertson, but large differences are found for Kr and Xe. The dispersions agree with those already recorded. Details of the very careful purification of the gases are given. Adsorption of the gases on the brass interferometer tubes was observed. C. B. A.

See also Abstracts 4822, 4826, 4959, 5074.

SPECTROSCOPY.

5015. Second Spectrum of Hafnium (Hf II). W. F. Meggers and B. F. Scribner. *Bureau of Standards, J. of Research*, 13. *pp.* 625–658, *Nov.*, 1934.—New data (wave-length measurements and intensity estimates) for more than 1000 lines characteristic of singly ionised hafnium atoms, including Zeeman patterns for 207 lines, are presented. Analysis has resulted in the interpretation of 862 lines as combinations of 117 atomic energy states, most of which are grouped and identified as doublet or quartet spectral terms. The normal state of the Hf^+ ion is represented by a doublet D term arising from the electron configuration $5d\ 6s^2$, and a tentative value of 14·8 volts is derived for the ionising potential. Attention is called to the extraordinary similarity between La I and Hf II spectra. AUTHORS.

5016. Effect of Mercury Vapour upon the High Terms of the Alkalis. B. Pontecorvo. *Accad. Lincei, Atti,* 20. *pp.* 105–109, *Aug.*, 1934.—The effect of the pressure of foreign gases (H_2, N_2, He, A) upon the high terms of the spectral series has been recently studied by Amaldi and Segré [see Abstracts 2499 and 2500 (1934)]. In this paper experiments are described on the effect upon the limit of the series of Na and K of a gas like the vapour of Hg which has a large section of impact for electrons of 0·5 volt, and for which nothing is known for lower values of the energy. In metallic vapours the course of the coefficient of absorption as function of the velocity of the electrons differs much from that of almost all other gases. In the case of the noble gases the section of impact has a maximum for electrons of some volts, falls rapidly when the velocity diminishes and reaches a minimum for electrons of velocity less than 1 volt. For the vapour of Hg on the contrary on diminution of the energy of the electrons the section of impact increases rapidly without attaining a maximum in the region of electronic velocity studied experimentally, which extends to a minimum value of 0·5 volt. Corresponding to a value of the energy of the electrons less than 0·5 volt the section of impact of the Hg attains a maximum, and for very small energies becomes some orders of magnitude less than the section of impact of electrons of 0·5 volt. Hg has a very feeble action on the high terms of the alkalis. J. J. S.

5017. Spectra of Potassium, K IV and K V, and of Calcium Ca V and Ca VI. I. S. Bowen. *Phys. Rev.* 46. *pp.* 791–792, *Nov.* 1, 1934.—From 19 to 36 new lines each have been identified in K IV, K V, Ca V and Ca VI. In K IV and Ca V these include singlet and intercombination lines. The presence in the nebulæ of lines due to the forbidden $^3P - {}^1D$ transitions in SI, Cl II, A III, K IV and Ca V is discussed. [See following Abstract.] AUTHOR.

5018. Highly Ionised Potassium and Calcium Spectra. A. E. Whitford. *Phys. Rev.* 46. *p.* 793, *Nov.* 1, 1934.—About 75 lines in the spectra of K VI, K VII, K VIII, K IX, Ca VII and Ca VIII have been classified from wave-lengths published by Ekefors. [See Abstract 121 (1932) and preceding Abstract.]

5019. High Series Terms in the Arc Spectrum of Mercury. I. Walerstein. *Phys. Rev.* 46. *pp.* 874–879, *Nov.* 15, 1934.—The spectrum of luminous mercury vapour drawn into a low pressure chamber was found to have the series lines developed to high members. Wave-length measurements of these higher members in the singlet and triplet diffuse and sharp series were made. The $^3S_1$ terms developed to $m = 20$ show that this series follows a Ritz formula accurately. The IS_0 series and especially the $^{1 \text{ and } 3}D$ series also follow a Ritz formula with definite indications of slight perturbations near the end of the series. AUTHOR.

5020. Arc Spectrum of Selenium. J. E. Ruedy and R. C. Gibbs. *Phys. Rev.* 46. *pp.* 880–888, *Nov.* 15, 1934.—The arc spectrum of selenium, as excited by means of a positive column discharge in helium, has been photographed over the wave-length range 300–11,000 Å. Four different grating spectrographs were used having dispersions of from 11 to 2·5 Å per mm. A total of 510 lines has been measured as belonging to the arc spectrum and of these 391 have been classified. Seven series built on the ^4S state of the ion have been carried to five or more members and the absolute term values are determined to within 0·2 cm^{-1}. All the $4p^4$, $4p^3(^2D)\ 5s$, $4p^3(^2P)\ 5s$, and $4p^3(^2D)\ 5p$ terms have been located and also some of the $4p^3(^2D)\ 4d$ terms. Perturbation effects are frequently evident and are illustrated by plots of the various series. AUTHORS.

5021. Absorption Spectra by Excitation of Inner Electrons. Part VIII. Thallium Spectrum between 2500 and 1400 Å by Excitation of the $(6s)^2$ Level (Tl I^b). H. Beutler and W. Demeter. *Zeits. f. Physik*, 91. 3–4. *pp.* 202–217, *Oct.* 2, 1934.—The absorption spectrum of Tl vapour between 2500 and 1400 Å is photographed against the background of the H_2 continuum and the many-lines spectrum. Lines are observed which do not belong to the arc spectrum of Tl, and these are interpreted as transitions of an electron from the $(6s)^2$ level whilst the valence electron $6p$ remains stationary. All the lines are attributed to the multiplet $(6s)^2\ 6p\ ^2P^0_{\frac{1}{2}} \rightarrow 6s\ (6p)^2\ ^{4,2}P$ and ^2D, and they form the "Tl I^b" spectrum (X-ray nomenclature : P_1-absorption). Several Tl absorption lines observed by Filippov and Prokofjew and by Kwater, Kremenewsky and Filippov are again recorded. One of these is attributed to the transition $(6s)^2\ 6p\ 2P^0_{3/2} \rightarrow 6s\ (6p)^2\ ^4P_{3/2}$, whilst one other of those seen by them at 2200–2100 Å finds a place in the term scheme. The terms of Tl I^b agree well with those of Pb I. The $^2D_{3/2}$ term over the Tl I series limit is very diffuse ; the $^{4,2}P_{3/2}$ terms are fairly sharp. [See Abstract 4549 (1934) and following Abstract.] C. B. A.

5022. Absorption Spectra by Excitation of Inner Electrons. Part IX. Thallium Spectrum between 900 and 600 Å by Excitation of the $(5d)^{10}$ Level (Tl I^c). H. Beutler and W. Demeter. *Zeits. f. Physik*, 91. 3–4. *pp.* 218–229, *Oct.* 2, 1934.—The absorption spectrum of Tl vapour is photographed between 900 and 600 Å against the helium continuum. Lines are observed which are believed to originate in the excitation of the $(5d)^{10}$ level of the neutral Tl atom $(5d)^{10}(6s)^2 6p_{\frac{1}{2}}$, since these lines lie beyond the energy required to set free a $6p$ or a $6s$ electron. The spectrum is named Tl I^c. (X-ray nomenclature : $O_{IV,\,V}$ absorption.) The sharpness of the lines observed varies considerably, which is held to indicate that (LS) coupling is involved, and that the term $[(5d)^9(6s)^2 6p_{\frac{1}{2}}]\ mp$, mf breaks down more easily into $(5d)^{10}(6s)^2$ + electron than into $(5d)^{10}\ 6s\ 6p_{\frac{1}{2}}$ + electron, although a lower kinetic energy of the two particles results in the latter case. The terms $O_{IV,\,V}$ from the X-ray emission, which indicate the transition of electrons from the $(5d)^{10}$ level into that of the conduction electron in the metal, are compared with the excitation energies of a $(5d)^{10}$ electron in the gaseous atom. [See preceding Abstract.] C. B. A.

5023. Wave-Length Shifts of the Spectral Lines of Sb Due to Change of Pressure. T. Yuasa. *Tokyo B.D., Sci. Reports*, 2. *pp.* 57–72, *Sept.* 20, 1934. *In English.*—The wave-length shifts and the modes of appearance of the spectral lines of Sb excited at relatively higher pressures, namely, a few cm. of Hg and the atmospheric, have been investigated, the wave-lengths being compared with those obtained at a pressure of a few mm. of Hg. The results have been discussed in relation to the spectral series. It was observed that the more the principal quantum number *n* and the inner quantum number *j* which define the terms concerning the emission of lines increase, the lines suffer the larger shifts of the wave-lengths and show the more remarkable change in the modes of appearance. The observations were also taken for a number of unclassified lines. AUTHOR.

5024. Intensity Measurements in the Fine Structure Triplet of As II. S. Tolansky and J. F. Heard. *Roy. Soc., Proc.* 146*A*. *pp*. 818–824, *Oct.* 15, 1934.—Accurate measurements of the intensity ratios in the fine structure triplet of AsII λ5231 ($5s\,^3P_1$–$5p\,^3P_0$) have been made by a method of photographic photometry. The spectrum was excited in a water-cooled hollow-kathode discharge and examined by means of a silvered Fabry-Perot interferometer. A method of reduction is described which takes into consideration the intensity distributions in the source and in the interferometer. The mean values of the triplet ratios obtained from 42 independent observations on six spectrograms are 0·98:2:2·99 which, within the 4 % probable experimental error, are in agreement with the theoretical values 1:2:3. This proves that the quantum weights of the fine structure levels in the $5s\,^3P_1$ term are proportional to $2F + 1$.
AUTHORS.

5025. Limitation of the Potential Theory of the Broadening of Spectral Lines. H. Kuhn and F. London. *Phil. Mag.* 18. *pp*. 983–987, *Nov.*, 1934. *Supplement.*—The spectral intensity distribution of an atom moving in a perturbing field deviates from the " occurrence distribution " (*Häufigkeitsverteilung*). An estimate is given for the amount of this deviation and for its dependence on the velocity. [See following Abstract.]
AUTHORS.

5026. Pressure Shift and Broadening of Spectral Lines. H. Kuhn. *Phil. Mag.* 18. *pp*. 987–1003, *Nov.*, 1934. *Supplement.*—(I) The statistical discussion of the limiting case of low velocities leads to a distinction between two regions :—(*a*) Small frequency changes are caused by the simultaneous presence of many neighbouring atoms. Only a very rough treatment is given. It yields proportionality between the shift of the maximum and the square of the density. (*b*) Larger frequency changes are caused by the influence of a single atom only. The intensity distribution can therefore be derived from the interatomic forces in a very simple way. (II) The influence of the atomic motion on the intensity distribution (I) can be estimated by the method given [see preceding Abstract]. This estimation shows the possibility of obtaining quantitative values of the polarisation attraction constants by measuring intensities in the wing of the broadened lines. (III) The region of small frequency changes (*a*) can be described by Lorentz' theory. A correction in the formula for the optical mean free path produces an appreciable reduction of the values hitherto used for the optical collision radii. Lorentz' theory describes only part of the real broadening effect. (IV) The experimental facts, as known at present, are discussed. A table of upper limits of optical collision radii ρ is given. Generally both Lorentz broadening and statistical broadening are of the same order of magnitude. The irregular behaviour of H_2, He, and atoms of high excitation is not unexpected. AUTHOR.

5027. Hyperfine Structure of Cs Line 4555 Å and Nuclear Moment of Cs Atom. H. Barth. *Zeits. f. Physik*, 91. 3–4. *pp*. 272–283, *Oct.* 2, 1934.—The intensity ratio in the hyperfine structure components of the 4555 Å line of Cs was measured. The value found was 1·41 ± 05 ; hence the nuclear moment of the Cs atom was deduced, the value $i = 5/2$ being obtained. The results are compared with those obtained by other workers from the separation of the lines in the hyperfine structure. D. H. F.

5028. Nuclear Spin of Sodium by the Method of Molecular Beams. I. I. Rabi and V. W. Cohen. *Phys. Rev.* 46. *pp*. 707–712, *Oct.* 15, 1934.—A simple method of velocity selection of arbitrary resolving power for atomic and molecular beams is described. The method consists in spreading the beam into a velocity spectrum, through the action of external fields, and then selecting a portion thereof by means of a movable selector slit. Since all the atoms of the beam of the given velocity interval are utilised, this type of selection has the maximum efficiency. In addition a method of focussing the selected beam to increase intensity and resolution is applied. A ballistic method of using the surface ionisation detector was evolved extending its use to beams of exceedingly low intensity. A selected beam of slow Na atoms, obtained and measured in this fashion, was analysed in a weak and inhomogeneous magnetic field. Four distinct peaks of equal intensity were obtained which represent the $(2i + 1)$ nuclear magnetic levels. The spin of the Na nucleus is accordingly equal to **3/2**, in units of $h/2\pi$. AUTHORS.

5029. Nuclear Spin of Cæsium. V. W. Cohen. *Phys. Rev.* 46. *pp.* 713–717, *Oct.* 15, 1934.—The spin of the cæsium nucleus has been measured by the deflection of a beam of atoms in a weak inhomogeneous magnetic field. The method utilises the fact that the magnetic moment of the atoms in some of the magnetic levels vanishes at certain values of the magnetic field. An examination of the variation of the intensity at the centre of the pattern yields distinct maxima at these fields. From the number and position of these maxima, the spin can be uniquely deduced. If the magnetic field is known, the hyperfine structure separation can be deduced with accuracy. The nuclear spin of Cs was found to be 7/2 in units of $h/2\pi$ and the hyperfine structure separation for the normal state was found to be $0{\cdot}295 \pm 0{\cdot}01$ cm.$^{-1}$. AUTHOR.

5030. Nuclear Magnetic Moment of Caesium from the Polarisation of Resonance Radiation. N. P. Heydenburg. *Phys. Rev.* 46. *pp.* 802–805, *Nov.* 1, 1934.—Measurements on the polarisation of resonance radiation in a magnetic field have been used to obtain the hyperfine separation constants of the $6\ {}^2P_{3/2}$ and $7\ {}^2P_{3/2}$ levels of Cs I. For a nuclear spin of 7/2 the hyperfine separation constant is $1{\cdot}42 \times 10^{-3}$ cm^{-1} for the $6\ {}^2P_{3/2}$ level and $4{\cdot}86 \times 10^{-4}$ cm^{-1} for the $7\ {}^2P_{3/2}$ level. From these values the nuclear magnetic moment is calculated as 2·40/1840 and 2·41/1840 Bohr magneton, respectively. These agree well with the value 2·52/1840 obtained from the splitting of the lower $6\ {}^2S_{1/2}$ level. The theoretical and experimental curves for the polarisation as a function of the magnetic field agree within experimental error when the shape of the exciting line in the source is taken into acount. AUTHOR.

5031. Nuclear Moments of Columbium from Hyperfine Structure. S. S. Ballard. *Phys. Rev.* 46. *pp.* 806–811, *Nov.* 1, 1934.—The hyperfine structure of the arc spectrum of columbium has been examined under conditions of high resolving power. The line patterns of λλ4059, 4080, 4117, 4137, 4168, 4649, 4672, 4675, 5344 and 6661 have been studied in detail. Three relatively independent methods have been used to determine the nuclear mechanical moment, $I^*h/2\pi$. All three methods indicate a value of 9/2 for I, the quantum number of nuclear spin. Using the formulæ given by Goudsmit, the nuclear g-factor has been calculated to be $g_I = 0{\cdot}83$. This gives for the nuclear magnetic moment $\mu_I = 3{\cdot}7$ nuclear magnetons. AUTHOR.

5032. Molecular Screening Constants. P. Das. *Indian Journ. Phys.* 9. *pp.* 35–43, *Sept.*, 1934.—Assuming that in a diatomic molecule with two electrons, the inner one screens the charge on each nucleus by

$\frac{1}{2}e$, the term values and the heat of dissociation of the molecules occurring in the following table are calculated by Hylleraas' method.

	LiH	BeH	Li_2
Heat of Dissoc^n. (Calc.) (in electron volts) ...	2·30	2·30	1·08
Heat of Dissoc^n. (Obs.) (in electron volts) ...	2·56	2·21	1·14

	$1s2p\,{}^1\Sigma$	$1s2s\,{}^3\Sigma$	$\frac{1}{2}\{1s2p({}^1\pi+{}^3\pi)\}$	$1s1s\,{}^1\Sigma$
Term value of H_2(Calc.) (in Rydberg unit) ...	−1·490	−1·416	−1·442	−2·32
Term value of H_2(Obs.) (in Rydberg unit) ...	−1·499	−1·469	−1·439	−2·33

AUTHOR.

5033. Spin Interaction with Exchange in Alkali Atoms. E. David. *Zeits. f. Physik*, 91. 5–6. *pp*. 289–317, *Oct*. 5, 1934.—The reversed alkali doublets cannot be explained without consideration of the exchange integral of the spin energy in addition to the classical energy of interaction of spin and orbital motion. The theoretical quantum mechanical formula for the exchange integral is derived and applied to a numerical calculation of the separation of the lithium 2*p* term, which although not actually a reversed doublet, has an abnormally small doublet separation of $\Delta\nu = +0{\cdot}34$ cm^{-1}. The classical integral gives a separation $\Delta\nu = +0{\cdot}71$ cm^{-1}. and the exchange integral a separation $\Delta\nu = -0{\cdot}45$ cm^{-1}, giving a net separation $\Delta\nu = +0{\cdot}26$ cm^{-1}. The agreement between experimental and theoretical values is good enough to justify the explanation of the abnormal separations in terms of exchange energy. The probable causes of the outstanding discrepancy of 0·08 cm^{-1} between theory and experiment are discussed. J. E. K.

5034. Effect of Inert Gases on the Afterglow Spectrum of Nitrogen. J. Ôkubo and H. Hamada. *Tôhoku Univ. Sci. Reports*, 23. *pp*. 281–288, *Aug*., 1934. *In English*.—To make a further confirmation of our assumption on the nature of active N [see Abstract 1433 (1933)] the effect of He, Ne and A, on the afterglow spectrum of active N has been investigated, and it was found that the intensity maxima at the bands having v′ = ∼ 11 and v′ = ∼ 6 are displaced towards the longer wave-length side with the increase of the partial pressure of inert gas, that of N being maintained at a constant value. The displacement of the maxima is least in A and greatest in He. The intensity distribution in the first positive bands in the nitrogen-inert gas mixture was also investigated in the case where the gas is excited by a very weak current, and it was found that, in the N-He and N-Ne mixtures, the maximum at v′ = ∼ 11 in the case of pure N is displaced towards the longer wave-length side, while the maximum at v′ = ∼ 6 remains almost unaltered, in the presence of the inert gas. From the assumption that the existence of non-vibrating metastable $A^3\Sigma$-molecules in active N is essential to the emission of the afterglow, it will be very difficult to account for the experimental results above-mentioned. The results will also serve to investigate the interchange of the vibrational and the translational energy in the molecular collisions, and are well explained by the theory put forward by O. Oldenberg, C. Zener and O. K. Rice. AUTHORS.

5035. Activation of Nitrogen by Electron Impacts. J. Ôkubo and H. Hamada. *Tôhoku Univ. Sci. Reports,* 23. *pp.* 289–295, *Aug.,* **1934.** *In English.*—The velocity of the electrons activating nitrogen gas was determined by using a sensible thermopile as an indicator for the presence of active N, and it was confirmed that the production of active N suddenly increases when the accelerating potential of electrons attains to 16·0 volts, which is the first ionisation potential of N_2. This result exactly agrees with that obtained by Kenty and Turner [see Abstract 1294 (1929)]. Above this ionisation potential, the production of active N increases gradually with the acceleration potential, but there are no sudden breaks in the curve showing the relation between the acceleration potentials and the deflections of the galvanometer connected with the thermopile. At such a moderate pressure (0·1 mm. → 10 mm.) that active N is readily generated, the primary production of molecular ions N_2^+ is essential to the formation of active N, and the probability of the formation of it by single collisions with high-speed electrons is relatively small. AUTHORS.

5036. Spectrum of Afterglow of Sulphur Dioxide. A. G. Gaydon. *Roy. Soc., Proc.* 146*A. pp.* 901–910, *Oct.* 15, 1934.—SO_2, when excited to luminescence in an electrical discharge at low pressure, has been found to possess a blue-violet afterglow of considerable intensity. The conditions of its production and the effect of change of pressure and electrical excitation on the spectrum have been investigated. The spectrum of the afterglow has been studied between 2400 Å and 6000 Å, and found to consist of about 20 narrow but headless bands in the region λ 3828 to λ 4699 and a continuum from 2400 Å to about 4500 Å. The band system has been analysed and found to give wave number intervals of about 1140 and 520 and a few intervals of 365. The first two of these intervals are known intervals of the ground state of SO_2. This indicates that the afterglow bands are due to the triatomic molecule SO_2. It is suggested that the lower of the excited states may have an energy equivalent to about 25746 cm^{-1}, with a vibrational level of an additional 365 cm^{-1} associated with it. From a consideration of the spectrum of the exciting discharge it seems probable that the afterglow is caused by the recombination of SO and oxygen in the form of a flame which gives the observed spectrum. [See Abstract 5275 (1933).] AUTHOR.

5037. Emission Spectra of the Vapours of Sodium and Potassium Halides. H. Hamada. *Tôhoku Univ. Sci. Reports,* 23. *pp.* 296–307, *Aug.,* 1934. *In English.*—Examination is made of the emission spectra of the halides of K and Na. For Na halides it is known that an apparently continuous emission spectrum having a maximum intensity in the immediate neighbourhood of the D-lines extends towards the red, diminishing at first and then, after passing through a region of almost constant intensity, gradually disappearing without showing a sharp edge. A continuous spectrum is observed also on the violet side of the D-lines. Structure of a diffused nature, however, is found only on the red side of the D-lines. This spectrum has its maximum range in the chloride, its minimum in the iodide. The intensity distributions in the above spectra are determined and discussed in terms of the relative positions of the various potential curves. Similar results are obtained for the potassium halides. A. H.

5038. Structure of Ozone and Its Infra-Red Bands. G. Hettner. R. Pohlman and H. J. Schumacher. *Zeits. f. Physik*, 91. 5–6. *pp.* 372–385, *Oct.* 5, 1934.—Ozone, prepared by ozonising electrolytic oxygen, was examined to 27 μ by a prism spectrometer. Bands are reported at 3·28, 3·57, 4·75, 5·75, 7·6, 9·65, 14·1 μ. Bands previously reported at 6·7 μ and 11·38 μ were not found and the band at 7·6 μ is definitely proved to arise from N_2O_5 since the addition of 1·7 mm. of NO_2 to 180 mm. of ozone increased the absorption in this region from 10 % to 50 %. The strongest absorption is at 9·65 μ. At 14·1 μ a new band was observed having two maxima at 13·8 and 14·4 μ. The most probable model is an isosceles triangle with an apical angle of 39°. W. R. A.

5039. Rotation-Vibration Spectrum of Acetylene. G. Herzberg and J. W. T. Spinks. *Zeits. f. Physik*, 91. 5–6. *pp.* 386–399, *Oct.* 5, 1934. —Using new Agfa infra-red plates a C_2H_2 band at 1·174 μ was photographed and completely measured. Re-investigation of the region 1·016 to 1·04 μ revealed two hitherto undetected diffuse bands at 1·04 μ. From the results of the present investigation and work on the C_2HD spectrum it is concluded that the assignment of acetylene frequencies due to Sutherland and Mecke cannot be correct. A new assignment is given which partially agrees with that of Lochte-Holtgreven and Eastwood. Anharmonic constants are derived. W. R. A.

5040. Near Infra-Red Absorption Spectrum of Mono-Deutero-Acetylene. A. McKellar and C. A. Bradley, Jr. *Phys. Rev.* 46. *pp.* 664–666, *Oct.* 15, 1934.—The absorption spectrum of mono-deutero-acetylene has been photographed over the region 6000–10,500 Å in the first order of a 21-ft. grating using absorbing columns up to 20 ft. in length at atmospheric pressure. One band was found with origin at 10,302 Å. It is attributed to the molecule C_2HD. From the rotational constants of the band and similar data from the C_2H_2 bands, the interatomic distances in acetylene are computed as $r_{CC} = (1{\cdot}247 \pm 0{\cdot}008) \times 10^{-8}$ cm. and $r_{CH} = r_{CD} = (0{\cdot}940 \pm 0{\cdot}036) \times 10^{-8}$ cm. AUTHORS.

5041. Infra-Red Absorption Spectrum of Heavy Water. T. Shidei. *Phys. Math. Soc., Japan, Proc.* 16. *pp.* 362–364, *Oct.*, 1934. *In English.*—The absorption of heavy water has been studied in a Kiff and Zonen auto-recording glass spectrometer. Cells with glass windows were used to hold the water and the thickness of the absorbing layer was 0·3 mm. When heavy water replaced distilled water the bands of the latter at 1·98 μ, 1·46 μ and 1·18 μ were reduced considerably, and new bands appeared at 2·11 μ, 1·64 μ and 1·32 μ (faintly). Three fundamental frequencies were estimated, *viz.*, $\delta(\pi)$, 6·8 μ (1470 cm.$^{-1}$); $V(\pi)$, 3·8 μ (2623 cm.$^{-1}$); $V(\sigma)$, 2·9 μ (3477 cm.$^{-1}$). Tables of data are included. H. H. Ho.

5042. Influence of Temperature on the Near Infra-Red Absorption Bands of Organic Liquids. B. Bloch and J. Errera. *Comptes Rendus*, 199. *pp.* 713–715, *Oct.* 15, 1934.—Observations of the absorption bands of organic liquids in the near infra-red over a temperature range of about 100° C. indicate the following conclusions: (1) The bands associated with C–H, C = O, C–Cl, N–H are not influenced by temperature. (2) The O–H band at 1·6 μ undergoes very marked changes. Thus, in amyl alcohol, as the temperature rises, a second band at 1·46 μ appears, and this finally supersedes that at 1·6 μ. No explanation is attempted. C. B. A.

5043. Absorption Spectra of Organic Molecules in the Vapour State. R. A. Rehman, R. Samuel and Sharf-ud-Din. *Indian Journ. Phys.* 8. 6. *pp.* 537–545, *June*, 1934.—Observations with straight and branched-chain alkyl halides show that the nature of the organic radicals has little influence on the absorption spectra; with rise of temperature the long wave-length limit moves towards the red. Ethylene dibromide exhibits an absorption spectrum completely different from those of the simple halides, *viz.*, a well developed band system ending in predissociation at 2548 Å; there is no direct correlation between the thermal and optical energy data. Predissociation occurs at 2750 Å for formaldehyde and carbonyl chloride, and at 3050 Å for acetaldehyde. Acetyl chloride exhibits predissociation at 2750 Å with overlapping continuous absorption having maxima at 2480 and 2150 Å. With the heavier molecules the band system is not observed, its place being taken by the long wave-length part of a continuous spectrum. For molecules containing the C:O group the point of predissociation represents an energy of 109–110 k.cal./mol., compared with 188 k.cal. calculated for the heat of dissociation of the C:O group; the primary decomposition is thus concerned with some linkage in the molecule other than the C:O, but the results are influenced but little by the nature of this linkage. H. F. G.

5044. Absorption Spectra of Three Isomers of Potassium Pentachlororuthenite. S. Aoyama and T. Fukuroi. *Tôhoku Univ. Sci. Reports*, 23. *pp.* 420–430, *Aug.*, 1934. *In English. Report No.* 329 *of the Research Inst. for Iron, Steel and other Metals.*—The absorption spectra for visible and ultra-violet rays were examined for HCl solutions of potassium hexachlororuthenite, potassium pentachlororuthenites and its aquo-salt; it was found that in potassium pentachlororuthenite three kinds of isomers exist. [See Abstract 5094 (1934)]. AUTHORS.

5045. Absorption of Light by Porphyrins. A. Stern and H. Wenderlein. *Zeits. f. phys. Chem.* 170. *Abt.A.* 5–6. *pp.* 337–350, 1934.—The absorption spectra of several porphyrins have been measured in solution in dioxan and in aqueous HCl. The influence of various substituents on the positions of the maxima and minima in dioxan solution is discussed. In some cases, definite differences in the molecular extinction coefficients in both dioxan and acid solutions could be established. In this way it is shown that pseudo-verdoporphyrin-dimethylester is not isomeric with rhodoporphyrin-dimethylester. C. B. A.

5046. Ultra-Violet Absorption Spectrum of Osmium Tetroxide. A. Langseth and B. Qviller. *Zeits. f. phys. Chem.* 27. *Abt.B.* 1–2. *pp.* 79–99, 1934.—The ultra-violet band absorption of $Os\,O_4$ is observed in the gaseous state from room-temperature up to 300° C. The absorption-spectrum of $Os\,O_4$ in various solvents (water, hexane and CCl_4) are observed, and the extinction curves of $Os\,O_4$ in water and in hexane are given. The Raman effect of the gas was recorded, and attempts were made to excite an emission spectrum. The structure of the molecule is concluded to be most probably regular tetrahedral. A. C. M.

5047. Comparison of Carbonyl Group in Aldehydes and Ketones with Carbon Monoxide. V. Henri. *Comptes Rendus*, 199. *pp.* 849–851, *Oct.* 29, 1934.—The experimental data for the frequencies of the CO radical and CO gas, including new measurements of the absorption spectra of aldehydes and ketones in the middle and extreme ultra-violet regions, are reviewed, and it is concluded that the CO radical in these compounds is in the $^3\Pi$ state, which corresponds to the first state of activation of the CO molecule. On activation, the radical passes into the $^3\Sigma$ state. In thermal or photochemical decomposition, when CO gas and a molecule containing no carbonyl is formed, one of the first stages is the passage of the CO group from the $^3\Pi$ to the $^3\Sigma$ state. This mechanism will explain the high electric moments of aldehydes and ketones as compared with the very low moment (if any) of CO gas. C. B. A.

5048. Absorption Spectra of Bromine Trifluoride, Iodine Pentafluoride and Cyanogen Fluoride. C. F. White and C. F. Goodeve. *Faraday Soc., Trans.* 30. *pp.* 1049–1051, *Nov.*, 1934.—BrF_3 and IF_5 both exhibit continuous absorption at short ultra-violet wave-lengths, whilst CNF in columns up to 1 m. at pressures up to 380 mm., is transparent in the range of the present measurements down to 1850 Å. The values of the thresholds of absorption are discussed. A further interesting spectrum, due to a compound of unknown identity, is also recorded. C. B. A.

5049. Absorption Spectra of Coordination Compounds of Chromium and Cobalt in Aqueous Solution. A. Mead. *Faraday Soc., Trans.* 30. *pp.* 1052–1058, *Nov.*, 1934.—The absorption spectra of the molecular ions $[M(C_2O_4)_3)]^{---}$, $[M\ en(C_2O_4)_2]^-$, $[M\ en_2C_2O_4]^+$ and $[M\ en_3]^{+++}$, M being Cr^{3+} or Co^{3+}, have been measured in aqueous solution. Each gives two broad bands in the visible and near ultra-violet spectra, the maxima of which stand in approximately constant relationship to one another. These are attributed to two states of excitation of the coordination electrons. Progressive replacement of oxalate ions by ethylenediamine produces regular displacements of the maxima in the chromic compounds and less regular displacements in the cobaltic series. The anomalous behaviour of cobalti-oxalate is possibly connected with instability of the upper level of excitation. All the bands are symmetrical on a scale of wave-lengths and can be represented by the absorption formula of Lowry and Hudson. C. B. A.

5050. Absorption and Emission Band Spectra of Rubidium. E. Matuyama. *Tôhoku Univ. Sci. Reports,* 23. *pp.* 308–321, *Aug.,* 1934. —Three types of bands due to Rb_2 have been studied. (1) The bands having discrete vibrational structure: they appeared at 4300, 4800, 6800 and 8600 Å. The bands at 6800 and 8600 Å are due to the transitions $^1\Pi_u - {}^1\Sigma_g$ and $^1\Sigma_u - {}^1\Sigma_g$ respectively. The three systems at 4300, 4800 and 6800 Å have been analysed. Their lower levels are common, and the vibration quantum being 58 cm^{-1}. (2) The diffuse bands due to the polarisation molecules: they appeared near the principal lines and these bands were only observed in emission. (3) A continuous spectrum of unknown origin: it appeared at 6000 Å. In order to account for the nature of the spectrum, the corresponding ones which appear in K and in Na were photographed both in emission and in absorption, and the appearance and the origin of the spectrum are discussed. AUTHOR.

5051. Absorption Band Spectra of Cæsium. E. Matuyama. *Tôhoku Univ., Sci. Reports,* 23. *pp.* 322–333, *Aug.,* 1934. *In English.*—The absorption spectra of cæsium were photographed under high dispersion so that the vibrational structure could be analysed. Four bands at 7200, 7600, 8200 and 8700 Å were observed near the resonance lines, and the two systems at 7200 and 7600 Å have been analysed. The other band at 6300 Å which has been measured by Rompe has also been analysed. The vibration quanta of this heavy molecule are very small, the value for the normal state being 40 cm^{-1}, and the values for the excited states are still smaller. A relation which exists between the vibration quanta of the diatomic molecules and the atomic weights of the constituent atoms in the case of alkali-metals as well as of other groups of the periodic table is shown. A marked feature of the appearance of the band systems of this metal is that the absorption increases gradually from the long wave-length side and reaches a maximum at the short wave-length side, and from there the absorption suddenly breaks off. The cause of this fact is explained by use of a modified Franck-Condon diagram. AUTHOR.

5052. Absorption Spectra of Mixed Vapours of Sodium and Potassium with Mercury, Cadmium and Zinc. E. Matuyama. *Tôhoku Univ. Sci. Reports*, 23. *pp.* 334–342, *Aug.*, 1934. *In English.*—The absorption band spectra due to the mixtures of vapours of Hg, Cd or Zn with K or Na have been studied. Two types of bands were observed. One having some intensity fluctuations, appeared in a very narrow region in the case of K alloys, and the other having discrete heads appeared in the case of Na alloys, and one of them has been analysed. It is considered that these two types are possessed equally by the K and by the Na alloys. AUTHOR.

5053. Band Systems of Mercury. T. S. Subbaraya. *Indian Acad. Sci., Proc.* 1*A*. *pp.* 166–177, *Sept.*, 1934.—The known band systems of mercury are discussed in terms of current theoretical views. A value of 0·25 volt is deduced as the heat of dissociation of the ground state of the mercury molecule. A. H.

5054. Absorption Spectrum of Acetylene between 2350 and 2050 Å. A. Jonesco. *Comptes Rendus*, 199. *pp.* 710–713, *Oct.* 15, 1934.—About 80 bands, which are degraded towards the visible and show sharp fine structure, are recorded in the absorption of acetylene in the extreme ultra-violet. A number of series are tabulated and attributed to probable transitions from various levels in the normal state to a series of levels in the final state which are very closely multiples of a frequency of 2708 cm^{-1}. Another frequency, 1034·6 cm^{-1}, which is obtained in the analysis, is identified with the frequency of the final state of the molecule. C. B. A.

5055. Band Spectrum of Arsenic Oxide (AsO). F. C. Connelly. *Phys. Soc., Proc.* 46. *pp.* 790–800, *Nov.* 1, 1934.—Two systems of bands have been photographed under moderately high dispersion, and their vibrational structure has been analysed. The A system degrades towards the red and extends from λ 3450 to λ 2950, and the B system degrades away from the red and extends from λ 2800 to λ 2350. Both are doublet systems, and each component band has a double head formed by two branches. The systems arise from transitions between two excited $^2\Sigma$ levels and a $^2\Pi$ ground level having a separation of 1026 cm.$^{-1}$. between the Π components. AUTHOR.

5056. Ultra-Violet Absorption Spectrum of Acetone Vapour. W. A. Noyes, Jr., A. B. F. Duncan and W. M. Manning. *J. Chem. Phys.* 2. *pp.* 717–725, *Nov.*, 1934.—The ultra-violet absorption spectrum of acetone vapour has been photographed. The well-known absorption region in the neighbourhood of 3000 Å, common to all ketones, is found to have on its long-wave end a series of discrete absorption bands. The wave-lengths of many of these bands have been measured and a vibrational analysis is given. A second absorption region beginning about 1960 Å and extending toward shorter wave-lengths is found to consist of several groups of bands, the bands within each group being separated by relatively small frequency differences. The analysis of this band system may be accomplished by assuming several energy levels close together in the upper state together with four fundamental frequencies in the upper state and two in the lower. Evidence for further absorption regions extending to below 1200 Å has been found and the approximate positions of these regions are given. These bands evidently belong to different electron transitions from the others. [See Abstract 4512 (1934).] AUTHORS.

5057. Spectrum of H_2. O. W. Richardson and T. B. Rymer. *Roy. Soc., Proc.* 147*A. pp.* 24–27, *Nov.* 1, *and pp.* 251–292, *Nov.* 15, 1934.—Part I describes a number of new bands and a new band system ending on the lowest triplet level $2p\,^3\Pi$ of H_2. They are: (1) the $4d\,^3\Delta_a \rightarrow 2p\,^3\Pi$ system; (2) the substitution of new $\nu' = 2$ and $\nu' = 3$ levels in $4d\,^3\Pi_b$ for the levels given by Richardson and Davidson; (3) the non-diagonal bands and some minor alterations of and additions to $4d\,^3\Sigma, \Pi_{ba}, \Delta_b \rightarrow 2p\,^3\Pi$; (4) the extension of the $3s\,^3\Sigma \rightarrow 2p\,^3\Pi$ system to the $\nu' = 0, 2, 3$ and (?) 4 levels; (5) the extension of the [illegible] $\Sigma\,\Pi\,\Delta$ complex $\rightarrow 2p\,^3\Pi$ to the $\nu', \nu'' = 4', 4''$ levels. The band constants and more important properties of the new levels are worked out. Part II describes four new band systems which go down to the lowest triplet state $2p\,^3\Pi$ of H_2 from four hitherto undiscovered upper triplet states. These are called provisionally ^{3}A, ^{3}B, ^{3}C and ^{3}G. The constants and properties of the upper states are worked out and the possible electronic configurations considered. It seems fairly certain that ^{3}G is either $1s\sigma\ 5d\sigma\ ^3\Sigma_g$ or $1s\sigma\ 5g\pi\ ^3\Pi_a$ and ^{3}C $1s\sigma\ 5d\delta\ ^3\Delta_b$ or $1s\sigma\ 5d\pi\ ^3\Pi_b$. ^{3}B is probably an "abnormal" state of the type of ^{1}Q in the singlet systems. The interpretation of ^{3}A presents some difficulties which are discussed. Part III describes three new band systems ending on $1s\sigma\ 2s\sigma\ ^3\Sigma$, the lowest even triplet state of H_2, and coming from three hitherto undiscovered upper states called provisionally ^{3}D, ^{3}E, and ^{3}F. It also describes bands coming from two new vibrational levels of the same state as the yellow band described by Richardson and Das and ending on $\nu'' = 0$ and $\nu'' = 2$ of $2s\,^3\Sigma$ instead of $\nu'' = 1$ of $2s\,^3\Sigma$. Finally an account is given of a new progression of the singlet system $^1Q \rightarrow 2p\,^1\Sigma$. This proves to be the $\nu' = 0$ progression and the one previously known is now shown to be the $\nu' = 1$ progression. The band constants and the properties of the upper states are worked out and discussed. It is fairly certain that ^{3}E is $1s\sigma\ 4f\sigma\ ^3\Sigma_u$ and ^{3}F is $1s\sigma\ 5f\sigma\ ^3\Sigma_u$. The upper state of the yellow band system and ^{3}D are probably "abnormal" odd triplet states analogous to the "abnormal" states like ^{1}K, ^{1}L, etc., of which there are so many examples in the even singlet states of H_2. AUTHORS.

5058. Quantitative Absorption Measurements in the Band Spectra of Zinc and Cadmium Vapours. S. Mrozowski. *Zeits. f. Physik*, 91. 9–10. *pp.* 600–608, *Oct.* 14, 1934.—By a photoelectric method, the absorption coefficients of Zn and Cd vapours are measured for various wave-lengths and their dependence on the temperature of the saturated vapour investigated. The variation of the absorption with wave-length is found to be very similar to that observed in Hg vapour, analogous deviations from a quadratic dependence on pressure being observed. C. B. A.

5059. Intensity Measurements in the First Positive Bands of Nitrogen. A. Elliott and W. H. B. Cameron. *Phys. Soc., Proc.* 46. *pp.* 801–804, *Nov.* 1, 1934.—The integrated intensities of bands in the first positive system of nitrogen have been measured by the method of photographic photometry, the d.c. and h.f. discharges, and the afterglow of active nitrogen being used as sources. The measurements show that in the cases examined the probability of transition between two vibrational levels is independent of excitation conditions. AUTHORS.

5060. Intensity Distribution in Band Spectra of Diatomic Molecules. M. Wehrli. *Helv. Phys. Acta*, 7. 7. *pp.* 676–683, 1934. *In German.*—The intensity distribution in the band spectrum of a molecule deviates from that customarily obtained if the separations of the equilibrium positions of the nuclei in the two electronic states (before and after the absorption or emission of the bands) are the same whilst the corresponding nuclear vibration frequencies are different. In this case it is found that only transitions in which the change of oscillation quantum number is even are permitted. This selection rule applies approximately in the molecular spectra of InI and GaI, and can then be put on a wave-mechanical basis. C. B. A.

5061. Rotation of Diatomic Molecules. H. Casimir. *Physica*, 1. *pp.* 1073–1076, *Oct.–Nov.*, 1934. *In English.*—It is shown that in order to calculate the moment of inertia of a diatomic molecule the masses of the closed electron shells must be added to the masses of the corresponding nuclei. [See Abstract 2682 (1934).] AUTHOR.

5062. Vibrations of Tetrahedral Pentatomic Molecules. Jenny E. Rosenthal. *Phys. Rev.* 46. *pp.* 730–733, *Oct.* 15, 1934.—Various specific assumptions as to intra-molecular forces are discussed from the point of view of the general theory and are compared with experimental data. CH_4 is found to be the only molecule even approximately to obey valence forces. For some other molecules satisfactory results are obtained by postulating an additional repulsive force inversely proportional to some power of the distance between the corner atoms. Certain relations between the frequencies of the isotopic molecules are found to be independent of the values of the force constants. For YX_4^* definite upper and lower limits may be predicted for the values of the active frequencies. [See Abstract 2519 (1934).] AUTHOR.

5063. Halogen Molecules and Their Spectra. JJ-Like Coupling. Molecular Ionisation Potentials. R. S. Mulliken. *Phys. Rev.* 46. *pp.* 549–571, *Oct.* 1, 1934.—The relations between molecular and atomic ionisation potentials are discussed, and rules are formulated, differing for non-bonding, bonding, and anti-bonding electrons. Comparisons are made between ionisation potential values predicted by these rules and observed values for N_2, CO, X_2, HX (X = halogen). Low-energy states of the halogen ions X_2^+ and $(XY)^+$ are discussed, and certain properties predicted. From this the low-energy excited states of X_2 and XY are discussed and many new low-energy states are predicted. The predictions are used to give a reasonable interpretation of the observed absorption spectra of the XY and X_2 molecules, extending into the vacuum ultra-violet. Suggestions are also made for interpreting observed fluorescence and emission spectra. A. H.

5064. Continuous Emission Spectra of Iodine. K. Asagoe and Y. Inuzuka. *Tokyo B.D., Sci. Reports*, 2. *pp.* 73–87, *Sept.* 20, 1934. *In English.*—A study is made of the behaviour of parts of the emission spectrum of iodine as the pressure and the electrical conditions are changed. The spectra are photographed on a quartz spectrograph (EI) and photometered with a Moll microphotometer. The most striking feature encountered as the electrical conditions change is that a short continuum at λ 3460 is enhanced by increasing the excitation and is present with the heaviest excitation, *i.e.*, when lines of doubly-ionised iodine are present.

When the pressure is varied this same continuum is weakened by lowering of the pressure. Some interpretation of the results is attempted. A. H.

5065. Simple Phosphorescence in Alkali Halide Crystals. W. Roos. *Ann. d. Physik*, 20. 7. *pp.* 783–792, *Sept.*, 1934.—The photochemical colouring of alkali halide crystals resulting from the absorption in the " U " bands which they exhibit after being heated in the vapour of the metal [see Abstract 4938 (1933)] is associated with phosphorescence. The spectrum of the light then emitted consists of narrow equidistant double bands. The decay of intensity of these bands follows a simple exponential course. Their dependence on temperature is also studied, but the origin of the phosphorescence is not yet clear. Crystals exhibiting " U " bands can also be prepared by an electrolytic method, but the phosphorescence spectrum of such crystals consists only of a broad diffuse band. C. B. A.

5066. Fluorescent Radiation from N_2O. P. K. Sen Gupta. *Roy. Soc., Proc.* 146*A*. *pp.* 824–828, *Oct.* 15, 1934.—The β-bands of NO were obtained in fluorescence when N_2O was illuminated by light of suitable wave-length, showing that NO, which is one of the products of photochemical dissociation of N_2O is also excited during the process. AUTHOR.

5067. Anomalous Zeeman Effect in Individual Hyperfine Structure Components of the Mercury Resonance Line 2537 Å. Part II. The σ-Components. A. Žvironas. *Helv. Phys. Acta*, 7. 7. *pp.* 684–708, 1934. *In German.*—The methods previously described [see Abstract 2053 (1934)] are applied to a study of the σ-components of the hyperfine structure of Hg 2537 Å. Absorption curves are recorded in fields up to 7500 gauss for the filtered σ-light of the components $-25 \cdot 4$, for the filtered σ-light of the components O and $+ 11 \cdot 5$, and for the unfiltered σ-light of the hyperfine structure. So far as could be observed, the structure scheme proposed by Schüler and Keyston, and the separations calculated by Inglis, agree well with the experimental results. The value 20×10^{-3} cm.$^{-1}$ deduced by Inglis for the separation of the line B of Hg^{199} from *c* of Hg^{201} is also confirmed. On the assumption that the normal separation for the even-numbered isotope is 3/2 Lorentz units, the separation of the component Hg^{198} from the centre of gravity of B of Hg^{199} and *c* of Hg^{201} is $14 \cdot 5$ mÅ. Line *b* of Hg^{201} is displaced $1 \cdot 9$ mÅ toward longer wave-lengths relative to that of Hg^{198}. In agreement with the calculations of Inglis, it is concluded that a Paschen-Back effect occurs in fields from 12,000–16,000 gauss between the Zeeman components of the triplets of Hg^{201}. C. B. A.

5068. Paschen-Back Effect. Part II. JJ-Coupling (approx.) J. B. Green and R. A. Loring. *Phys. Rev.* 46. *pp.* 888–893, *Nov.* 15, 1934.—The Paschen-Back effect of four pairs of Hg lines, $\lambda\lambda$5789–90, 3662–63, 3131–32 and 2967–68, have been measured. The results have been found to be in good agreement with Houston's theory, both as to position and intensities of components. The red shift of the central component of λ5790 was studied in greater detail at several field strengths and was found to be practically proportional to the square of the field strengths. The Zeeman effect of several other mercury lines was also measured, and the *g*-values calculated from them were slightly different from the normal *g*-values, but are in general accord with the values calculated from perturbation theory. [For Part I see Abstract 1610 (1934).] AUTHORS.

5069. Raman Spectrum of Sulphur in Solid and Liquid States. C. S. Venkateswaran. *Indian Acad. Sci., Proc.* 1*A*. *pp.* 120–121, *Aug.*, 1934.—The Raman lines scattered by rhombic crystals of S and by molten

S were excited using a sodium vapour lamp. The two spectra were identical. Lines recorded were 150, 214, 467 cm.$^{-1}$. A. C. M.

5070. Raman Effect in Selenic Acid and Selenates. A. S. Ganesan. *Indian Acad. Sci., Proc.* 1*A. pp.* 156–162, *Sept.*, 1934.—Solutions were studied of the selenates of Na, K, NH_4 and Mg. All of these except the NH_4 salt were observed also as crystals, and in addition thallous selenate was so observed. The frequencies (cm.$^{-1}$) were: 835 strong, 875 faint, 415 and 345 medium. These frequencies are inserted in frequency equations for tetrahedral molecules and the force constants are evaluated, and the heat of dissociation calculated from them is found to be of a reasonable order. The Raman spectrum of a strong solution of selenic acid was studied, and found to be strikingly different from that of selenates. Five frequencies were found, 315 and 422 (medium), 730 and 926 (faint) and 850 (strong). A. C. M.

5071. Raman Effect of N_3^- and NCS^- Ions. A. Langseth, J. R. Nielsen and J. U. Sørensen. *Zeits. f. phys. Chem.* 27. *Abt.B.* 1–2. *pp.* 100–110, 1934.—The N_3^- ion was investigated by using a concentrated solution of sodium azide in water. A strong line was found at 1258 cm.$^{-1}$ and a very weak one at 1348 cm.$^{-1}$, considered to be an overtone ($2\nu_2$). Polarisation measurements were also made on the lines. It is concluded that the N_3^- ion is linear, with symmetry $D_{\infty h}$. Potassium rhodanide gave lines at 750,796, and 2066 cm.$^{-1}$, the last very strong. The structure of the rhodanide ion is concluded to be linear, $N \equiv C - S^-$. A. C. M.

5072. Raman Effect and the Complexity of the Mercurous and Thallous Ions. L. A. Woodward. *Phil. Mag.* 18. *pp.* 823–827, *Nov.*, 1934.—A nearly saturated solution of mercurous nitrate in 3 *N* HNO_3 shows, in addition to the bands of water and lines due to NO_3', a strong Raman frequency $\Delta\nu = 169$ cm.$^{-1}$ which is ascribed to the double form $(Hg - Hg)^{++}$ of the mercurous ion. The Raman spectrum of a nearly saturated solution of thallous nitrate gives no evidence of a double ion Tl_2^{++} or of undissociated $TlNO_3$ molecules. It is deduced that the Tl_2^{++} ion, if it exists, must have a concentration less than would correspond to 10 % of the total Tl present. AUTHOR.

5073. Steady Mercury Lamp. A. L. Johnsrud. *Rev. Sci. Instruments,* 5. *p.* 408, *Nov.*, 1934.—When an intense source of monochromatic light is required, which will be exceptionally steady in every sense, the Hippel type of mercury lamp is very suitable. Being of capillary type unsteadiness of the arc path is avoided, and automatic starting eliminates any disturbance of optical alignment. A. H.

5074. Projection Instrument for the Analysis of Spectrographic Plates. C. H. Edlin. *Journ. Sci. Instruments,* 11. *pp.* 357–359, *Nov.*, 1934.—The paper describes the design of an instrument for examining spectrographic plates by projecting them optically, under a magnification of × 10, on to a white horizontal surface. The plate is placed on a stage adjoining this surface, and can be easily adjusted by the observer while examining the image. A convenient method of calibrating the instrument for use with a given spectrograph is described. Wave-lengths can be read to an accuracy of ± 1 Å in the range 2100–3000 Å. For the comparison of spectra it is possible to project two plates simultaneously, both being in focus and subject to precisely the same magnification throughout their lengths. One objective only is embodied in the instrument. A simple and rapid method of photographing the enlarged spectrum is mentioned. AUTHOR.

See also Abstracts **4794, 4797, 4823, 4824, 4825, 4878, 4913, 4965, 4966, 4971, 5013, 5014, 5129.**

VELOCITY OF LIGHT.

See Abstract 5228.

VISION.

5075. Normal and Abnormal Colour Vision. H. E. Roaf. *Nature,* 134. *pp.* 442–445, *Sept.* 22, 1934. *Paper read before the British Assoc., Aberdeen, Sept.,* 1934.—The author disposes of possible objections to the trichromatic theory on the ground of the unitary character of the yellow sensation. The principal manifestations of congenital defective colour vision are described. Finally, the present position of the trichromatic theory is reviewed. W. S. S.

5076. Pupillary Reaction and Brightness Perception. G. v. Studnitz. *Naturwiss.* 22. *pp.* 627–633, *Sept.* 14, 1934.—Outlines recent work on the comparative physiology of the pupil reaction for vertebrates. The pupil size may be controlled directly by a light sensitive iris, or by the retina through the medium of a reflex arc. The size of the pupil for steady brightness, the reaction time, dilatation and contraction effects, and the smallest brightness change necessary to produce a minimal pupil change, are all considered. W. S. S.

5077. Measurability of Visual Sensation. F. H. Gage. *Roy. Soc., Proc.* 116*B. pp.* 123–138, *Oct.,* 1934.—The method of attack followed closely that already described in studying the measurability of auditory sensation [see Abstract 5158 (1934)]. The observer viewed three discs of white light against a dark background (diameter of discs = 38′, distance apart of adjacent discs = 76′), and adjusted the intensity of the centre disc so that its brightness appeared to bisect the brightness interval between the other two. Using the same system of bisections described for the case of sounds, it was found that X_3 and X_3^1 (expressed as densities of the sector and filter system used to vary the light intensity) could not be regarded as identical within the limits of experimental error. Thus a scale of visual sensation appears impossible. The results for each of the two observers in these experiments were evaluated separately. If the results of a number of observers in experiments of this kind are grouped together, different conclusions as to the measurability of sensation may be drawn. W. S. S.

5078. Vision of Fish. A. and C. Magnan and A. de Villelongue. *Comptes Rendus,* 199. *pp.* 736–738, *Oct.* 15, 1934.—A study of the eyes of common fish (trout, mackerel, pike) gave values of the refractive index of the crystalline lens ranging from 1·649 to 1·653. The refractive indices of the humours were found to equal that of water. The diameter of the crystalline lens and its distance from the retina were determined for several specimens of the species in question. A calculation of the focal distance of the eye system using the measured values of refractive index, suggests that fish may be slightly myopic. W. S. S.

X-RAYS.

5079. Electrical Characteristics of Constant H.V. Generators for X-Ray Work. Part I. Theory of Half-Wave Generators. G. E. Bell. *Brit. J. of Radiology*, 7. *pp.* 654–669, *Nov.*, 1934.—In the present paper, the circuit used in half-wave constant-voltage generators is considered mathematically, taking into account the effect of resistance, and it is shown that the observed electrical properties can be satisfactorily accounted for, and particularly that secondary resistances of the sizes commonly met with are sufficient to limit the condenser current to small values, and at the same time to produce a fall with load of the output voltage which is of the right order of magnitude. It is also shown that the magnitude of the charging current depends jointly on the secondary resistance and the condenser reactance, and when the resistance is high and the reactance low, the charging current is small, while for low resistances combined with high reactances the charging current is large. In the latter case, the performance of the generator may be influenced by the effect of the high current on the transformer or the rectifying valves. The bearing of these results on the design of constant-voltage generators is discussed. AUTHOR.

5080. X-Ray Output of a Constant-Potential H.V. Apparatus. J. E. Roberts. *Brit. J. of Radiology*, 7. *pp.* 685–693, *Nov.*, 1934.—Previous investigations of high voltage X-rays have been extended to a detailed consideration of the output of an X-ray tube up to 370 kV. A number of typical output curves are given. The theories of the intensity distribution in the continuous X-ray spectrum leading to the formula $I = KV^2$ for the energy output of a tube are briefly discussed. The values of the index of V in this formula are obtained from experimental results, and the effects of filtration are observed. It was found to be impossible to fit the results to the usual form of the formula $I = KV^p$ over the whole range of voltages used. Using unfiltered radiation the value of the index appeared to fall below the theoretical value of 2. It is suggested that this may be due to the breakdown of the ionisation method of measuring the energy output for soft radiations. AUTHOR.

5081. Continuous and Discontinuous Compton Spectrum for Hydrogen. F. Schnaidt. *Ann. d. Physik*, 21. 1. *pp.* 89–112, *Oct.*, 1934.—When X-rays are scattered by electrons bound in an atom, the Compton line for a given scattering angle is not a single frequency as for the free electron case, but a continuous band, owing to indeterminacy in the impulse moment of the bound electron at the instant of scattering. In addition to the continuous Compton band, there exists theoretically a kind of Raman line spectrum due to scattering processes in which the electron is transferred from its initial level to a higher level in the atom. The ordinary Rayleigh or unmodified scattering corresponds to the case of identical initial and final levels. Using the Schrödinger wave equation the intensity distributions within the Compton band and in the discontinuous line spectrum are evaluated for hydrogen-like atoms and the dependence of these distributions on scattering angle and nuclear charge are obtained. The intensities of the scattered Raman lines exhibit a maximum at a particular scattering angle. The first Raman line may at its maximum be one-fifth as intense as the unmodified line and the fact that it has not been definitely observed must be ascribed to its close proximity to the unmodified line. From the intensity distribution derived for the Compton " line," it is shown that only the loosely bound electrons of the outer shells of an atom give a well-defined line. W. S. S.

5082. Structure of the Compton Modified Band. G. E. M. Jauncey. *Phys. Rev.* 46. *pp.* 667–668, *Oct.* 15, 1934.—The distribution-in-wave-length of the intensity of scattered X-rays about the centre of the Compton modified band gives directly the distribution-in-component-velocity of the electrons producing the band. The two distribution functions are of the same form. AUTHOR.

5083. Effect of Electron Binding upon the Magnitude of the Compton Shift. P. A. Ross and P. Kirkpatrick. *Phys. Rev.* 46. *pp.* 668–673, *Oct.* 15, 1934.—Precision measurements of the Compton shift for 90° scattering of the wave-lengths 0·435 Å, 0·496 Å and 0·631 Å by C and by Be have been performed, using the ring-target X-ray tube and a double spectrometer, under the assumption that the mean shift for two mutually, supplementary angles of scattering equals the 90° shift. In all cases the observed shift is less than h/mc, the value required by the Compton formula, the maximum percentage discrepancy being 2·4 %, observed in the case of 0·631 Å scattered from carbon. These observations fulfil the predictions inherent in Wentzel's theory of scattering by bound electrons, and are consistent with the explicit shift formula previously deduced by the present authors, as regards dependence of the shift upon wave-length and upon ionisation energy of the scatterer. They are also in satisfactory quantitative agreement with the theoretical shift formulæ of F. Bloch. AUTHORS.

5084. Theory of the Compton-Line. F. Bloch. *Phys. Rev.* 46. *pp.* 674–687, *Oct.* 15, 1934.—Starting from Wentzel's theory of the Compton scattering of bound electrons, and assuming that the motion of the electrons in the atom can be described by hydrogenic eigenfunctions, general formulæ are developed for the calculation of the intensity distribution in the Compton line. It is shown that the interaction of the electrons with the atomic nucleus gives not only a broadening of the Compton line but makes it also asymmetrical, shifting at the same time the position of the maximum intensity from Compton's value $\Delta\lambda = (h/m_0c)\,(1 - \cos\theta)$. The " defect of the Compton shift " is shown to be quadratic in the wave-length of the incident radiation. This law as well as the value of the constant entering into it are found to agree satisfactorily with experiment. AUTHOR.

5085. X-Ray Absorption Coefficients. H. Lay. *Zeits. f. Physik*, 91. 7–8. *pp.* 551–555, *Oct.* 12, 1934.—Using the Jönsson formula, the mass absorption coefficients τ/ρ for a large number of elements and compounds, over a range of wave-lengths from 0·5 to 6 Å have been calculated. Tables of the values obtained are given. The absorption coefficients for the characteristic radiation of the absorber or its chief constituent are given for a number of elements and compounds. Oxygen and celluloid are considered in detail over the wave-length range. J. E. R.

5086. X-Ray Absorption Coefficient of Xenon. T. N. White. *Phys. Rev.* 46. *pp.* 865–867, *Nov.* 15, 1934.—The absorption coefficient of Xe was measured over a wave-length range 0·18 to 1·5 Å. The formula obtained for the mass-absorption coefficient was $655\lambda^{2.90} + 0{\cdot}7$ below, and $92{\cdot}8\lambda^{2.79} + 0{\cdot}7$ above the K discontinuity, giving values somewhat below Jönsson's " universal absorption curve." AUTHOR.

5087. Ionisation of Liquid Carbon Disulphide by X-Rays. F. L. Mohler and L. S. Taylor. *Bureau of Standards, J. of Research*, 13. *pp.* 659–664, *Nov.*, 1934.—The ionisation was measured in a layer of liquid between flat Al discs with spacings of 1 and 0·3 mm. Fields up to 60 kV per cm. were used and the current voltage curve rose continuously but at a decreasing rate in this range. A plot of the reciprocal of the current against the reciprocal of the field is a straight line above 20 kV and can be extrapolated to infinite field. The form of curve is consistent with the theory of columnar recombination and the intercept at infinite field gives the rate of production of ions. Comparison with the radiation in roentgens gives the ionisation per unit volume in liquid CS_2 as 2600 times that of air under standard conditions. The absorption is 1910 times that of air and the energy of ionisation per ion pair about 0·75 times that of air. The shape of the curve and the columnar theory give the diameter of the columns as $5 \cdot 8 \times 10^{-6}$ cm. and the density of ionisation in the columns as $2 \cdot 3 \times 10^{16}$ ions per cm^3. AUTHORS.

5088. K-Satellites of Potassium and Calcium. H. Tazaki. *Hiroshima Journ. Sci.* 4. *pp.* 185–190, *Sept.*, 1934. *In English.*—The previous work on the satellites of the K-β group of K [see Abstract 238 (1934)] is extended to the Kα group of K and the Kα and Kβ groups of Ca. The α_5 and α_6 lines of K and the α_{56} line of Ca are observed and the measured values of the α_5 and α_6 wave-lengths are compared with those calculated. J. T.

5089. Intensities of Satellites of Lβ_2. Anna W. Pearsall. *Phys. Rev.* 46. *pp.* 694–697, *Oct.* 15, 1934.—By use of the Siegbahn X-ray spectrograph, the intensities, relative to the parent line, of the satellites of the X-ray line Lβ_2, have been studied in the atomic number range $40 < Z < 53$, inclusive. The " integrated intensity " (total area of satellite structure, comprising four lines) is about 4 % of that of Lβ_2 for Cb(41) ; rises to a maximum of 52 % for Ag(47) ; and then drops rapidly to a value too small to be measured (less than 1 %) for Te(52). These results are in disagreement with the theory of Druyvesteyn (*Diss., Groningen,* 1928), which predicts a continuous decrease in satellite intensity with increasing Z. AUTHOR.

5090. Natural X-Ray Line Widths. Correction for Finite Resolving Power. L. G. Parratt. *Phys. Rev.* 46. *pp.* 749–754, *Nov.* 1, 1934.—The resolving power of the X-ray double spectrometer has been increased by a factor of 2 to 4 by employing etched quartz crystals. The shapes of the Kα lines of Mo, Cu and Ti have been observed in anti-parallel positions and the correction for the finite resolving power of the crystals is shown to be practically negligible. Data on the Au Lα line is also considered. AUTHOR.

5091. Widths of L-Series Lines and of the Energy Levels of Au(79). F. K. Richtmyer, S. W. Barnes and E. Ramberg. *Phys. Rev.* 46. *pp.* 843–860, *Nov.* 15, 1934.—Following a résumé of the Weisskopf-Wigner theory of the shape of spectral lines, and, making certain simplifying assumptions, an expression is derived for the shape of an X-ray absorption discontinuity for the case where absorption is due to the ejection of electrons from inner orbits to the continuum of unoccupied Fermi-Sommerfeld levels. If these levels be assumed equally distributed, the curve (μ *vs.* λ) is a simple arctangent, from which the width of the associated energy level (K, L · · ·), corresponding to the full width of half-maximum of a radiated line, may be read directly. A more complicated expression results if the Fermi-Sommerfeld levels be not equally distributed. It is shown that the predicted shape of an absorption limit agrees reasonably well with the observed shape of the L_{III} limit of Au(79), the width of which was found to be 4·4 volts. Data are presented on the widths of some 23 lines in the L-series of Au(79), obtained by a two-crystal spectrometer. These widths, corrected for effect of the crystals, vary from 7·6 to 20·8 volts. Making use of the conclusion of Weisskopf and Wigner, that the width of a line may be interpreted as the sum of the widths of the energy states involved, and starting from the value 4·4 volts for the width of the L_{III} state, the widths of the several L, M, N and O states of Au(79) are computed. For a given total quantum number *n*, the width decreases with increasing orbital quantum number *l*. States having the same value of *n*, *l* have nearly the same width. For any given *l*, the L states are narrowest. [See Abstract 4229 (1934).] AUTHORS.

5092. Direct and Fluorescence Excitation of the K-Level in Thick Targets of Copper. K. B. Stoddard. *Phys. Rev.* 46. *pp.* 837–842, *Nov.* 15, 1934.—The ratio P of the probability of exciting the K shell of copper by direct kathode-ray impact to the probability of exciting the same shell by fluorescence in a thick target, is measured with normally emergent rays over a range of voltages extending from 2 to 17·4 times the K excitation voltage. P is found to vary from 6·63 at U = 2 to 7·2 at U = 17·4, where U is the ratio of tube voltage to K excitation voltage. The ratio Q of the probability of a kathode ray ionising the K shell directly to the probability of a kathode ray exciting a continuous quantum of frequency greater than the K-limit frequency is found to be very nearly constant at 3·5 for the same voltage range. The variation of P with Z is examined theoretically and compared with experiment showing a lack of good agreement. AUTHOR.

5093. Fluorescent Efficiency in L Region. H. Lay. *Zeits. f. Physik*, 91. 7–8. *pp.* 533–550, *Oct.* 12, 1934.—The efficiency of fluorescent excitation of L rays from a number of elements has been redetermined by the method of Hevesy and Alexander. A few were also examined in the K region and uranium in the M region. The efficiency is found to increase with atomic number—linearly up to Sa (from Zr) and then faster. Within the experimental error (10 %) the efficiency is independent of the exciting wave-length and of the state of combination. Comparing two equal wave-lengths—K of one element and L of another (heavier) element, it is found that the K output is larger than the L. Indeed the relative efficiency ratio for such cases is found to be constant. The K:L:M ratio (equal wave-lengths) was found to be 18:10:6. J. E.

5094. X-Ray Absorption Spectra. S. Aoyama and T. Fukuroi. *Tôhoku Univ. Sci., Reports*, 23. *pp.* 405–419, *Aug.*, 1934. *In English. Report No.* 328 *of the Research Inst. for Iron, Steel and other Metals.*—With an improved vacuum spectrograph of Siegbahn type, the time of exposure was shortened by one-half and the troubles usually met with during the experiment were eliminated by removing the membrane in the slit. Different kinds of grease used in the experiment are also described. The absorption spectra of Cl, K and Ru in potassium hexachlororuthenate and three isomers of potassium pentachlororuthenite were measured. From these results it was concluded that α and β salts of potassium pentachlororuthenite are isomers. A marked difference between α and β salts was also observed in Debye-Scherrer photographs. [See Abstract 5044 (1934).] AUTHORS.

5095. Two-Crystal Study of the Structure and Width of K X-Ray Absorption Limits. W. H. Zinn. *Phys. Rev.* 46. *pp.* 659–664, *Oct.* 15, 1934.— The double-crystal spectromer has been used to examine the

K absorption limits of the elements Se, Rb, Zr, Mo and compounds of these elements. All of the substances examined show structure either on the short wave-length side of the main absorption limit or in the limit itself. The intensity and location are discussed with reference to the theory of secondary structure given by Kronig. The widths of the absorption limits have been measured and it is shown that the widths are approximately constant for elements of atomic number less than 32 and that from there on they increase as the fourth power of the atomic number. AUTHOR.

5096. Structure and Width of the L_{III} Absorption Limits of Tantalum, Tungsten and Gold. H. Semat. *Phys. Rev.* 46. *pp.* 688–691, *Oct.* 15, 1934.—The double crystal spectrometer was used to investigate the structure and widths of the L_{III} absorption limits of the elements Ta, W and Au, in the free metal and in compounds. Curves of these absorption limits are presented. Tables are given of the measured values of the wave-lengths and of the widths of these limits, and also the relative displacement of these limits in compounds. The widths, in volts, of the L_{III} absorption limits increase with atomic number. There is a decrease in absorption on the short wave-length side of the main edge for these elements corresponding to an absorption line on the short wave-length side of the main edge. Evidence is given to support the hypothesis that X-ray energy levels have definite energy widths. AUTHOR.

5097. Secondary Structure of X-Ray Absorption Edges from Elements in Certain Cubic Crystals. G. P. Brewington. *Phys. Rev.* 46. *pp.* 861–864, *Nov.* 15, 1934.—The K X-ray absorption spectra of K, Cl, Ca and S in several different cubic crystals have been photographed. The absorption spectrum was obtained for potassium from filters prepared with KF, KCl, KBr and KI, and the Cl spectrum from LiCl, NaCl, KCl, RbCl. The Ca and S absorption spectra were obtained from powdered CaS. A secondary structure was found on the short wave-length side of the K edge of each of these elements. The following results are not in accord with the demands of the Kronig theory for secondary structure :–The absorption spectra of two elements in the same crystal are not similar. The product of the separation of each of the secondary structure components in volts and the square of the lattice space is not a constant for the crystals studied. Some of the structure previously reported for the S edge is shown to be due to the S contained in goldbeater's skin which had been used to cover the slit of the X-ray tube. AUTHOR.

5098. Absolute X-Ray Wave-Lengths by Refraction in Quartz. J. A. Bearden and C. H. Shaw. *Phys. Rev.* 46. *pp.* 759–763, *Nov.* 1, 1934.—The refractive index of quartz for Cu $K\alpha_1$ radiation was measured by means of the double crystal spectrometer. The quartz prism was placed between the two crystals of the spectrometer and the deviation measured. Measurements were made with the X-rays incident both internally and externally on the prism. Accuracy was such that the refractive index could be determined as $1 - \mu = \delta = (8{\cdot}553 \pm 0{\cdot}005) \times 10^{-6}$. The absolute wave-length of the X-rays was calculated from the quantum theory of dispersion and was found to agree with wave-lengths as measured by ruled gratings. With the newer data on fundamental constants, positions of the critical absorption limits of Si and O and the resonating strengths of bound electrons the previous photographic results were recalculated and found likewise to substantiate the ruled grating value. AUTHORS.

5099. Variation of the K Resonating Strength with Atomic Number. J. A. Wheeler and J. A. Bearden. *Phys. Rev.* 46. *pp.* 755–758, *Nov.* 1, 1934.—The resonating strength of the K-shell or the effective number N_k of K electrons is less than 2 and varies with atomic number. It is determined in the present paper by an approximate theory using Hartree wave functions. The results are compared with N_k values obtained by anomalous dispersion, by computation from the most reliable absorption experiments, and by an approximate absorption theory of Hönl and Williams. Below atomic number 40 the present theory gives good results and allows of the determination of the N_k values which are needed in finding absolute X-ray wave-lengths from dispersion measurements. AUTHORS.

5100. X-Ray Ionisation in "Air-Equivalent" Chambers. E. Miehlnickel. *Ann. d. Physik,* 20. 7. *pp.* 737–772, *Sept.,* 1934.—The measurement of X-ray dosage rate in medical radiology is defined, by means of the röntgen, in terms of ionisation produced in air. When small closed ionisation chambers are used for this measurement, the greater part of the ionisation is due to secondary electrons released from the walls. It is important therefore that the wall material should be " air-equivalent." A large number of mixtures, chiefly of carbon and silicon, have been investigated and the effective atomic numbers determined. A mixture of 91 % C and 9 % Si has the same effective atomic number as air for the longer wave-lengths, but at the shorter wave-lengths (0·05 to 0·5 Å), it decreases more rapidly than air. A mixture of 97 % C and 3 % Si, while giving a lower absolute effective atomic number, runs parallel with air over the whole range of wave-lengths. It is therefore necessary to put the definition of air-equivalence on a broader basis and to consider always the variation of effective atomic number with wave-length. Direct measurements of the electronic emission from plates of mixtures of light elements have been made. The electrons are collected in a hemispherical aluminium chamber, the effects due to direct air ionisation being compensated by the ionisation in a free-air parallel-plate chamber. Radiations over a range from 25 kV-p. unfiltered to 145 kV-p. with 0·5 mm. Cu filtration were used. Curves are given showing the variation of electron emission with quality of radiation, and with composition of the irradiated material. To take into account the incomplete absorption of secondary electrons in an enclosed chamber, the hemispherical collector was replaced by a parallel plate chamber and the variation of the electronic ionisation current with plate separation and quality investigated. It is concluded that, in order to be independent of wave-length, a closed ionisation chamber must have " air-equivalent " walls over the whole wave-length range, and a geometrical construction whereby the free flow of secondary electrons into the chamber is not obstructed. J. E. R.

5101. Air Density Corrections for Temperature and Pressure Applied to X-Ray Ionisation Chambers. L. S. Taylor and G. Singer. *Radiology,* 23. *pp.* 404–409, *Oct.,* 1934.—The international roentgen is defined only for a given density (as affected by temperature and pressure) of normally dry air. Since ionisation measurements are usually carried out at other than the standard density, corrections must be made. These corrections are discussed and their applications are given for (*a*) standard ionisation chamber measurements, (*b*) calibration of thimble chambers against a standard, (*c*) clinical use of thimble chambers at other than the prescribed air density, (*d*) radioactive leaks for ionometer sensitivity control, (*e*) radioactive compensators for ion current measurement. The subject is discussed mathematically from first principles and the correction factors, embodied graphically. B. J. L.

5102. Specification of Heterogeneous X-Rays. H. Nitka. *Phys. Zeits.* 35. *pp.* 801–806, *Oct.* 15, 1934. *From the Reichsanstalt.*—For the complete specification of a heterogeneous X-ray beam, at least two quantities are required, the penetrating power and the degree of inhomogeneity. The penetration may be defined in terms of the first half-value layer in an absorbing medium; the inhomogeneity is best represented by the Christen-Holthusen method, as the ratio of the second to the first half-value layer. X-ray beams which coincide in these two conditions may be termed iso-homogeneous. By graphical methods the effects of voltage and filter on the penetration and homogeneity of X-rays from different generators are investigated. A number of curves are given showing the increase of first half-value layer with kV for various primary filters. The homogeneity ratio $(\text{h.v.l.})_2/(\text{h.v.l.})_1$ falls rapidly as the filtration increases to 1 mm. Cu (200 kV), and then approaches a constant value. In an investigation of the differences in the radiations from a Villard (pulsating e.m.f.) and a Liebenow (constant e.m.f.) generator, it is shown that when the maximum voltages and the first half-value layers are equal, the Villard radiation has a larger homogeneity ratio than the Liebenow. It is shown that, from the point of view of quality of radiation, the constant potential generator is always more efficient than the pulsating generator. J. E. R.

5103. Depth Distribution of Origins of Characteristic X-Rays from Thick Targets. P. Kirkpatrick and D. G. Hare. *Phys. Rev.* 46. *pp.* 831–836, *Nov.* 15, 1934.—If I is the intensity of any X-ray wavelength as observed in a direction making an angle ϕ with the face of the (thick) target in which the radiation originates, then

$$S_T = \frac{-1}{\mu}\left(\frac{\mathrm{d}\log I}{d\csc\phi}\right)_{\csc\varphi=0}$$

is the depth of the centroid of the X-ray luminosity distribution in the target. This depth is greater than the effective mean depth of production by an amount which depends upon the angle of observation and the form of the luminosity distribution. For large angle observation of Ag Kα at 100 kV (and probably at any voltage) the two depths are identical within the errors of measurement. The distributions of X-ray luminosity with target depth for Ag Kα from a thick target are calculated for six tube potentials from 50 kV to 185 kV from the intensity observations of Webster, Hansen and Duveneck. There is as yet no theory of these distribution functions. The characteristics of the curves obtained are shown to be capable of fairly simple mathematical description and to be in harmony with certain physical checks. AUTHORS.

See also Abstracts 4828, 4831, 4832, 4833, 4971, 5021, 5022, 5136, 5137, 5192, 5197.

HEAT.

CALORIMETRY.

5104. Temperature Dependence of the Heats of Rotation of Methane. R. Renner. *Phys. Zeits.* 35. *pp.* 811–814, *Oct.* 15, 1934.—The problem of the temperature dependence of the heats of rotation of methane has been already outlined by Elert [see Abstract 421 (1929)], in connection with transformation properties which are specific for the Schrödinger eigenfunctions of the spherical top with tetrahedral rotations. Further Villars and Schultze [see Abstract 512 (1932)] have calculated the heats of rotation using the Elert data, but their theoretical curves especially at low temperatures are in general not in agreement with the experimental results of Heuse. This circumstance has led the author to study the problem anew and while on the one hand he has tested and confirmed Elert's data and fundamental outlook, he has also critically examined the calculations of Villars and Schultze. The differences between previous theory and experiment have now been traced to their proper sources and brought into harmony. H. H. Ho.

5105. Specific Heat of Gases at High Temperatures by the Sound Velocity Method. Part I. Carbon Monoxide. G. G. Sherratt and E. Griffiths. *Roy. Soc., Proc.* 147*A*. *pp.* 292–308, *Nov.* 15, 1934.—The experiments recorded in this paper carry the determination of the specific heat of CO by the sound velocity method up to a temperature of 1800° C. By working with more than one frequency and correcting the data for the effect of frequency on the velocity of sound in the gas the specific heat in the temperature range 1000° to 1800° C. is found to be in good agreement with that deduced from spectroscopic data. Specific heats based on sound velocity measurements in various gases have not hitherto been found to be in accord even at moderately high temperatures with those obtained from spectroscopic data. It is probable, in the light of the present work, that the discrepancy is due to the fact that observers have based their conclusions on measurements made with a single frequency. From practical and theoretical considerations it is now known that the velocity of sound in a gas is not necessarily independent of the frequency. Corrections can be applied to the published values of specific heats of gases, at various temperatures, which are based on sound velocity measurements, when more accurate data become available as to the periods of relaxation of the vibrational specific heats of the different gases. There is every reason to believe that the discrepancy between the two sets of values will be greatly diminished. AUTHORS.

5106. Anomaly in the Specific Heat of Rochelle Salt. A. A. Rusterholz. *Helv. Phys. Acta*, 7. 7. *pp.* 643–644, 1934. *In German.*—Rochelle salt is remarkable in that its dielectric constant over the temperature range − 20° to + 25° C. has the extremely high value of 20,000 and more. The present work shows that there is an increase in the specific heat, which sets in at about 23° C. The excess over the normal value reaches a maximum of about 5 cal./mol./° C. at 25·8° C. and falls sharply to zero at 26° C., when the normal value of 104 cal./mol./° C. is regained. This behaviour is analogous to that of a ferromagnetic substance in the neighbourhood of its Curie point. L. G. C.

5107. Anomaly in the Specific Heat of Lithium. G. W. Pankow and P. Scherrer. *Helv. Phys. Acta*, 7. 7. *pp*. 644–647, 1934. *In German.*—Debye's theory of specific heats should be applicable to monatomic substances crystallising in the cubic system. However, diamond, silicon, gray tin and the alkali metals deviate from the Debye curve. The anomaly has been explained by Simon in terms of an intra-atomic transformation which involves the absorption of energy and gives to the specific heat an additional term which can be represented by a Schottky function. In applying this idea to lithium, Simon has represented the observed specific heat by means of a Schottky function with a characteristic transformation temperature of 205° together with a Debye function with a characteristic temperature $\theta = 510°$. The present authors have determined the characteristic temperature by measurement of the temperature dependence of the intensity of X-ray interference, between liquid air and room-temperature, and obtain $\theta = 350°$, which is much lower than that required by Simon's hypothesis. A value of θ of the order of 350° is also in better accord with the specific heat measurements at very low temperatures and with the variation of resistance with temperature.
L. G. C.

5108. Heats of Fusion of $TiCl_4$, CCl_4 and $SbCl_5$. N. Nasu. *Tôhoku Univ. Sci. Reports*, 23. *pp*. 374–383, *Aug*., 1934. *In English. Report No*. 326 *of the Research Inst. for Iron, Steel and other Metals*.—The heats of fusion of $TiCl_4$, CCl_4 and $SbCl_5$ were calculated from the depression of freezing point in dilute solution. They are respectively 12·90, 4·40, and 6·40 cal./gm. These values are in agreement with those observed by previous investigators. AUTHOR.

5109. Microcalorimetry. B. Whipp. *Phil. Mag*. 18. *pp*. 745–759, *Nov*., 1934.—A discussion is given of a method of general microcalorimetry of greatly increased sensitivity. AUTHOR.

See also Abstracts 4878, 4891, 5126.

CONDUCTION.

5110. Thermal Conductivity of Diatomite at Moderately High Temperatures. C. D. Niven. *Canad. J. of Research*, 11. *pp*. 249–253, *Sept*., 1934.—An examination was made of various kinds of diatomite brick, in order to ascertain how the thermal conductivity of diatomite found at Quesnel in British Columbia compared with the conductivities of some other diatomites. A brief description is given of the difficulties in measuring thermal conductivity with accuracy above 1500° F. and which necessitate the limiting of the investigation to temperatures between atmospheric temperature and 1500° F. Of the samples investigated the Quesnel brick was found to be the best thermal insulator with the exception of a brick consisting of natural Californian diatomite. AUTHOR.

See also Abstracts 5191, 5238.

CONVECTION.

5111. Heat Transfer for Turbulent Flow in Pipes. H. Lorenz. *Zeits. f. techn. Physik*, 15. 10. *pp*. 376–377, 1934.—A supplement to earlier papers on this subject [see Abstract 2941 (1934)], giving results of measurements of the velocity and temperature distributions close to the smooth wall of a heated tube through which air is flowing. The two distributions are similar, but not quite identical. R. W. P.

DILATATION.

5112. Thermal Expansion of Silver, Quartz and Bismuth. A. H. Jay. *Zeits. f. Krist.* 89. 3–4. *pp.* 282–285, *Oct.*, 1934. *In English.* —The thermal expansions of silver, quartz, and bismuth are measured by the powder method, precision measurements being employed. The same values are obtained as by optical methods indicating that the expansion of the atomic lattice does not differ from that of the crystal as a whole. J. T.

5113. Thermal Expansion of Alkali Halides and Metals at High Temperatures. A. Eucken and W. Dannöhl. *Ziets. f. Elektrochem.* 40. *pp.* 814–821, *Nov.*, 1934.—A special method and apparatus details are described at length for the purpose of measuring the expansions of Ag, LiF, KCl, KBr, KI, NaCl, Pb, Ag, Cu and Ni. Data by previous observers are included. H. H. Ho.

5114. Thermal Expansion of Jena Thermometer Glass 2954^{111} by the Vertical Comparator Method. W. H. Keesom and D. W. Doborzyński. *K. Onnes Lab. Leiden, Comm. No.* 234*a*. *Physica*, 1. *pp.* 1085–1088, *Oct.–Nov.*, 1934. *In English.*—With a view to measurements to be carried out with the aid of a gas thermometer made of Jena glass 2954^{111} the thermal expansion of this kind of glass was investigated. In this paper the results of measurements down to − 253° C. by the vertical comparator method as introduced by van Agt and K. Onnes are dealt with. They can be summarised in the following formula, valid (by extrapolation) from + 100° C. to − 273° C.: $l = l_0\,[1 + \{a\tau + b\tau^2 + c\tau^3 + d\tau^4 + e\tau^5\} \times 10^{-6}]$, where $a = 545{\cdot}89$, $b = 19{\cdot}55$, $c = 17{\cdot}16$, $d + 27{\cdot}99$, $e = 5{\cdot}24$, and $\tau = t/100$. AUTHORS.

5115. Thermal Expansion of Jena Glass 2954^{111} Down to 4° K. by the Interferometric Method. W. H. Keesom and D. W. Doborzyński. *K. Onnes Lab., Leiden, Comm. No.* 234*b*. *Physica*, 1. *pp.* 1089–1102, *Oct.–Nov.*, 1934. *In English.*—Measurements were made by the interferometric method of Fizeau-Abbe-Pulfrich on the thermal expansion of Jena glass 2954^{111} down to the temperature of liquid helium. Measurements were made relative to fused quartz and absolute. The results compare quite well with the results of measurements by the comparator method. Small differences in the expansion coefficient appear to exist between different samples, either dependent on conditions as regards annealing or thickness of wall, or even independent from these. From a comparison of the results of both series of measurements it would seem that the expansion coefficient of fused quartz decreases to 0, when approaching absolute zero. AUTHORS.

5116. Autographic Thermal Expansion Apparatus. W. Souder, P. Hidnert and J. F. Fox. *Bureau of Standards, J. of Research*, 13. *pp.* 497–513, *Oct.*, 1934.—The apparatus employs the optical lever method of measuring expansion and is suitable for many purposes in commercial laboratories. Continuous expansion curves can be obtained photographically or they can be observed during the progress of the test. Coefficients of expansion can be determined from these curves and transformation regions, if present, can also be located. For ordinary materials such as steel, it may be stated that the error of the autographic expansion apparatus is about 6 % for the range from 20 to 100° C. and about 3 % for the range from 20 to 500° C. This apparatus does not give as accurate results as the fused quartz tube expansion apparatus. The autographic expansion apparatus yields certain information in regard to transformation regions not readily obtainable by the other type of apparatus. AUTHORS.

See also Abstracts 5145, 5146.

MELTING AND BOILING POINTS.

5117. Melting Parameters of Nitrogen and Argon under Pressure and the Nature of the Melting Curve. P. W. Bridgman. *Phys. Rev.* 46. *pp.* 930–933, *Nov.* 15, 1934.—New measurements have been made of the melting parameters (pressure-temperature coordinates of the melting curve and change of volume) of nitrogen and argon up to 5500 kg./cm.^{2}, and the latent heat of melting has been calculated from them. The qualitative behaviour of these parameters is exactly like those of all other normal substances (with rising melting curves) hitherto measured, so that there is no experimental basis for the expectation of a critical point between liquid and crystalline phases, or of a maximum or of an asymptotic temperature, but all the experimental evidence indicates only a rise of the melting curve to indefinitely high temperature and pressure. AUTHOR.

5118. Liquefaction of Helium by an Adiabatic Method. P. Kapitza. *Roy. Soc., Proc.* 147*A. pp.* 189–211, *Nov.* 1, 1934.—An expansion engine is described which works without lubrication at low temperatures, and an account is given of its use for the liquefaction of helium. The liquefier is pre-cooled by liquid nitrogen only, and further cooling of the helium is done in two stages : down to 10° K. by means of the expansion engine, and finally down to liquefaction point by using the Joule-Thomson effect. It has been found that it is probable that the Joule-Thompson effect has a pressure inversion point at these low temperatures and that this appears at a pressure of about 17 atmospheres. The starting time of the liquefier is 1¼ hr., and the output is 2 l. per hr., using 1½ l. of liquid nitrogen to produce 1 l. of liquid helium. AUTHOR.

5119. Volatility of Silica. E. Preston and W. E. S. Turner. *Soc. Glass Technol., J.* 18. *pp.* 222–224, *Sept.*, 1934.—Fused transparent silica discs suffered no loss in weight when heated in air for 20 hours at 1400°. Experiments in which similar discs were subjected to the action of steam showed that in 20 hours at 1300° the loss in weight was negligible, but in 20 hours at 1400° and in 4 hours at 1500° the loss was small but appreciable. The surface in contact with the steam became slightly pitted and glossy. AUTHORS.

5120. Activation Energy of Evaporation and Condensation. N. Fuchs. *Comptes Rendus de l'Acad. des Sciences, U.R.S.S.* 3. *pp.* 335–340, *Aug.* 11, 1934. *In German.*—It is suggested that the hypothesis of Miyamoto [see Abstract 4154 (1933)], according to which only those molecules whose vibrational energy exceeds a certain value can escape from or enter a solid or liquid surface, leads to a dependence of the potential energy of a molecule on its distance from the surface. This potential energy curve rises to a maximum of ϕ_k above the surface and falls to a minimum E below the surface. ϕ_k is the activation energy for condensation, and if

ϕ_e is the activation energy for evaporation, then $\phi_e = \phi_k + E$ where E is the heat of evaporation at absolute zero. The kinetic theory of evaporation shows that usually $\phi_e = E$, and $\phi_k = 0$. Reference is then made to a number of experiments from which values of ϕ_k might be derived. These include the condensation of silver and of mercury and the emission of electrons from a metal. Invariably the value obtained for ϕ_k is zero or a very small quantity. R. W. P.

5121. Drop Formation in Vapours. M. Volmer and H. Flood. *Zeits. f. phys. Chem.* 170. *Abt.A.* 3–4. *pp.* 273–285, 1934.—The formation of drops in vapours subjected to adiabatic expansion was studied in an apparatus based on C. T. R. Wilson's cloud chamber, with a view to testing the nuclear formation theory of Volmer and Farkas. The relation between the critical supersaturation of water vapour and temperature is in satisfactory agreement with the theory. The critical super-saturation of vapours of the following alcohols, ethyl, n-propyl, iso-propyl, and butyl, and also of nitromethane and ethyl acetate were also in agreement with the theory. Methyl alcohol exhibits a discrepancy. The results are discussed. [See following Abstract.] P. H. B.

5122. Drop Formation in Supersaturated Ethyl-Alcohol-Water Vapour Mixtures. H. Flood. *Zeits. f. phys. Chem.* 170. *Abt.A.* 3–4. *pp.* 286–294, 1934.—The same apparatus was used for this work as for the work of Volmer and Flood [see preceding Abstract]. The experimental results are in agreement with the theory of Volmer and Farkas and show that the critical expansion ratio is a maximum (4·85) for pure water vapour, falls rapidly to a minimum (1·7) at between 20 % and 25 % of C_2H_5OH and then slowly rises to 2·3 at 100 % C_2H_5OH. P. H. B.

See also Abstracts 4787, 4835, 4889, 5123, 5124, 5200, 5201.

TEMPERATURE, MEASUREMENT OF.

5123. Freezing Point of Platinum. F. H. Schofield. *Roy. Soc., Proc.* 146*A*. *pp.* 792–817, *Oct.* 15, 1934.—The freezing point of platinum on the International Temperature Scale has been determined by measuring the ratio of brightness, for a certain wave-length, of black-body radiators held at the freezing points of platinum and gold, the latter being the basic point of the scale for all high temperatures. The radiators consisted of hollow enclosures of refractory materials immersed in ingots of the metals which were heated by electromagnetic induction and also for gold, in an ordinary resistor type of furnace. Observations on five ingots of platinum and two of gold yielded a mean value of $1773 \cdot {}_3$° C. ± 1° C. for the freezing point of platinum. This value is indistinguishable from the only previous one obtained by the same method. AUTHOR.

5124. Freezing Point of Gallium. W. F. Roeser and J. I. Hoffman. *Bureau of Standards, J. of Research,* 13. *pp.* 673–676, *Nov.,* 1934. —The temperature of equilibrium between liquid and solid gallium was found to be 29·780 ± 0·005 ° C. Four determinations on two different lots of metal all yielded the same result. Difficulties ascribed to the undercooling and low thermal conductivity of the gallium prevented a satisfactory determination from ordinary heating and cooling curves. The temperature of equilibrium between the liquid and solid phases of the metal was obtained by measuring the temperature of an intimate mixture of the solid and the liquid. It was found that the presence of the oxide did not affect the freezing temperature, indicating that the oxide is not appreciably soluble in the metal. AUTHORS.

See also Abstract 5216.

THERMOCHEMISTRY.

5125. Water as a Weak Electrolyte in the Heats of Dilution of Strong Electrolytes. E. Doehlemann and E. Lange. *Zeits. f. phys. Chem.* 170. *Abt.A.* 5–6. *pp.* 391–406, 1934.—With measurements of the heats of dilution of aqueous salt and acid solutions, thermal effects are obtained due to changes in the electrolytic dissociation of water, *viz.* (1) in the case of neutral salt solutions, as a consequence of changes of activity coefficients; (2) in the dilution of acids, through the effect of the H-ions introduced from the water; (3) as an effect of salt hydrolysis. The thermal influences due to deviations of the diluting water of $pH = 7$ are also discussed. After correction of the earlier V_m curve for NH_4Cl, the new V_m curve is found to be in good agreement with the V_m curves of the other methyl substituted ammonium salts. The influence of the above factors is also discussed from the thermodynamic standpoint, and, in addition, the changes in the state of polymerisation of water are taken into account. H. H. Ho.

5126. Heat of Combustion of Standard Sample Benzoic Acid. R. S. Jessup and C. B. Green. *Bureau of Standards, J. of Research,* 13. *pp.* 469–495, *Oct.*, 1934.—The bomb calorimeter and the methods of calibrating it and determining heats of combustion are briefly described. In an extensive series of observations, the value obtained for the heat of combustion of standard sample benzoic acid is 24,619 international joules per gram mass (weight corrected for air buoyancy) when the same is burned at 25° C. in oxygen under an initial pressure of 30 atmospheres absolute, in a bomb of constant volume, the mass of sample and the mass of water placed in the bomb each being 3 gm./l. of bomb volume. This value is in agreement within 0·03 % with the values deduced from the data obtained in 1928 by Roth, Doepke, and Banse, and by Jaeger and v. Steinwehr, but is lower by 0·07 and 0·06 % respectively than the values deduced from the data obtained by Fischer and Wrede in 1909 and by Dickinson in 1914. AUTHORS.

5127. Thermal and Electrical Theories of Spark Ignition. J. D. Morgan. *Phil. Mag.* 18. *pp.* 827–832, *Nov.*, 1934.—Gaseous molecules in and around an electric spark derive their motion from two agencies, *viz.*, heat and the action of the electric field. If it can be assumed that activation of gaseous molecules results from molecular collisions, then it should be experimentally possible to test whether the activation caused by an electric spark is due to the two agencies above, and the present paper records such an attempt. The experiment is based on the two facts: (1) that a wire which is heated electrically to a temperature below incandescence, and which produces no observable electrification in its immediate neighbourhood, can cause the constituents of an inflammable gas mixture to combine, and (2) that such a mixture can be exposed to a strong electric (but sparkless) discharge from a needle point for a long time without any apparent sign of combustion. The conclusion arrived at is that, under the conditions described, the activating effect of the heat of the wire could not be supplemented by ionised molecules moving in the neighbourhood of the wire under a strong electric field, but that such effect could be supplemented by radiation of the kind given off by a needle point when subjected to a pulse of electrical pressure. H. H. Ho.

5128. Reaction between Oxygen and Deuterium. C. N. Hinshelwood, A. T. Williamson and J. H. Wolfenden. *Roy. Soc., Proc.* 147*A*. *pp.* 48–57, *Nov.* 1, 1934.—D_2 reacts more slowly than H_2 with O_2. For the surface reaction on silica the ratio of the rates is from 0·6 to 0·7 at 525° C. For the chain reaction in the gas at 550° to 560° C., the ratio is 0·6 in the early stages of the reaction, but falls to about 0·4 as steam accumulates in the system. In the early stages the smaller diffusion coefficient of the chain carriers in deuterium partly compensates for the lower reactivity, but, as the reaction goes on, the steam minimises the compensation and allows the inherent difference in reactivity to appear more completely. The upper limit of the " low pressure " explosion region is higher with D_2 than with H_2. The shift can be quantitatively accounted for in terms of the smaller number of deactivating ternary collisions made by the D_2. No difference in the probability of chain branching need be assumed. This lends support to the hypothesis that the branching depends upon a process in which no linkages involving H or D are broken. AUTHORS.

5129. Equilibrium Constant of the Reaction, HDO + $H_2 \rightleftarrows H_2O$ + HD. T. Förster. *Zeits. f. phys. Chem.* 27. *Abt.B.* 1–2. *pp.* 1–5, 1934. —This equilibrium constant has been calculated from spectroscopic data, and better agreement with the experimental data is obtained when the zero-point energy of the HDO-molecule is derived not from the observed fundamental frequencies of Bartholomé and Clusius, but from the more exactly known frequencies of the H_2O molecule taking into account the mass change. H. H. Ho.

5130. Equilibrium H_2O + HD $\rightleftarrows$ HDO + H_2. L. and A. Farkas. *Faraday Soc., Trans.* 30. *pp.* 1071–1079, *Nov.*, 1934.—The equilibrium constant, $K_3 = [HDO]\cdot[H_2]/[H_2O]\cdot[HD]$, has been determined over the temperature range 3° to 450° C. The equilibrium constant in the gaseous state is 2·61 at 25° C. and varies with temperature according to the formula $\log K_3 = 750/2\cdot3\ RT - 0\cdot1335$. AUTHORS.

5131. Isotopic Equilibria in the Hydrogen-Hydrogen Oxide System. R. H. Crist and G. A. Dalin. *J. Chem. Phys.* 2. *pp.* 735–738, *Nov.*, 1934.—Experiments are described in which the distribution of deuterium between hydrogen and water vapour at equilibrium at 800° K. is investigated. The equilibrium constants of the reactions necessary to describe the system H_2, HD, D_2, H_2O, HDO and D_2O are calculated and the amount of each constituent calculated for various concentrations of deuterium. The distribution of deuterium between the hydrogen and the water is calculated and found to agree with the experimental data. AUTHORS.

5132. Wave-Mechanics of Reactions Involving Hydrogen and Diplogen. R. A. Smith. *Cambridge Phil. Soc., Proc.* 30. *pp.* 508–513, *Oct.* 30, 1934.—Previous attempts in this field have been insufficient for several reasons, *viz.* (1) the proton, if bound before reaction, will oscillate about its equilibrium position with a period often much smaller than the effective time of collision, while the form of the barrier changes during the collision ; (2) in certain circumstances, the proton will cross and recross the barrier in a time small compared with the collision time ; (3) some mechanism for redistributing the energy difference between the initial and final states of the proton must be taken into account. The chemical reaction is now treated as a problem of transitions between two stationary states, simplified for the case when the final and initial stationary states of the proton have the same energies. Although the method given is only approximate, it is believed to be a step in the right direction and is applied to calculate the effect of exchange of protons and diplons in the reaction, $H_2O + D_2O \rightarrow 2\,DOH$, using the model of Fowler and Bernal. From this result some deductions are made about the exchange of diplogen with hydrogen in a water solution. An attempt is also made to set lower limits to the heights of the potential barriers through which a proton and diplon have to pass in exchange between a D_2 molecule and H_2O and OH_3, in order that the reaction rates should be slow enough to be in agreement with observation. H. H. Ho.

5133. Activation Energies of Reactions Involving Oxygen. Part I. Reaction $O + H_2 = H_2O$. R. S. Bear and H. Eyring. *Am. Chem. Soc. J.* 56. *pp.* 2020–2025, *Oct.*, 1934.—The results recorded indicate a broad but low (2 or 3 k.-cal.) activation hump for a ^1D oxygen atom approaching a hydrogen molecule. A normal atom requires more activation (about 8 k.-cal.) and also has a barrier of high curvature at the maximum. Such barriers of very high curvature, which can arise with a change in multiplicity, may well be effective in the separation of isotopes by the tunnel effect. There is also an additional slowness of reaction resulting from transition between states of different multiplicities. These results are in satisfactory agreement with the known experimental facts. In reactions which convert polar into non-polar compounds, or *vice-versa*, the activated state may occur at distances for which the polar forces are relatively unimportant. This rapid disappearance of the polar part of the bond is associated with the customary high ionisation potential of atoms and molecules, which makes the polar level lie high above the homopolar one at activated state configurations. Most ionic reactions are rapid, though in solutions hydration effects are a complication and in oxidation-reduction reactions involving the approach of highly-charged ions of like signs reaction is sometimes slow. T. H. P.

See also Abstracts 4880, 4881, 4890, 5032, 5192, 5220.

THERMODYNAMICS.

5134. Theory of Liquids. Part II. T. S. Wheeler. *Indian Acad. Sci., Proc.* 1*A*. *pp.* 105–113, *Aug.*, 1934.—The theory outlined in Part I [see Abstract 4252 (1934)] is extended, and formulæ are deduced relating μ, the attractive force coefficient, to the parachor, and giving the force between two molecules at the distance of closest approach. The formulæ for γ and L_i are modified to include both attractive and repulsive forces, and values of the force constants calculated from the equations of state of certain gases by the Lennard-Jones method are inserted in these formulæ. The calculated results obtained are in good agreement with the theoretical values. AUTHOR.

5135. Properties of Real Gases Based on the Thermodynamic Equation of State. Part I. Joule-Thomson Effect of Helium. W. Jacyna (Jacyno). *Zeits. f. Physik*, 91. 5–6. *pp.* 349–352, *Oct.* 5, 1934. —The dependence of the Joule-Thomson effect on pressure and temperature has been calculated in the region of − 150° to 500° C. and from 0 to 100 kg./cm.^{2} from the standpoint of the simplified form of the thermodynamic equation of state, $vp = R\psi - ap\,\{10\,\psi_0 - t\,(1 - 11\,e^{b}\,\sqrt[4]{p\,\psi})\}$.

[see also Abstract 4254 (1934)]. The data are expressed both in tabular and graphic form, and an explanation is thereby afforded of Roebuck and Osterberg's negative experimental results. H. H. Ho.

5136. Cybotactic Condition of Ethyl Ether in the Region of the Critical Point. R. D. Spangler. *Phys. Rev.* 46. *pp.* 698–703, *Oct.* 15, 1934.—X-ray diffraction ionisation current waves have been taken at 37 combinations of values of pressure, temperature and specific volume near the critical point of ethyl ether. The results have been interpreted on the basis of the cybotactic view of molecular organisation in liquids. It has been found that the groups are very sensitive to changes in specific volume but show much less dependence on temperature and pressure; that the groups disappear at approximately the same specific volume at various values of temperature and pressure; that groups may appear in the gaseous state; and that beyond a certain specific volume no groups appear and the curves are of the gas type. Using the cybotactic view a rather definite picture is obtained of what occurs in fluid near the critical point. AUTHOR.

5137. Cybotactic Condition of Isopentane in the Region of the Critical Point. C. A. Benz and G. W. Stewart. *Phys. Rev.* 46. *pp.* 703–706, *Oct.* 15, 1934.—X-ray diffraction-ionisation curves have been obtained, at various values of pressure, volume and temperature, of isopentane near the critical point. The results are: (1) that, as is the case with ethyl ether, the specific volume is unique in determining the extent of cybotactic groups; (2) that the specific volume at which these groups disappear is 90 % greater than the critical volume; (3) that the internal description of liquefaction above the critical pressure, as the fluid passes from gas to liquid, is the same for both isopentane and ethyl ether. AUTHORS.

5138. Transport Phenomena in Degenerate Gases and their Bearing on White Dwarfs. A. Ganguli and P. Mitra. *Indian Journ. Phys.* 9. *pp.* 81–89, *Sept.*, 1934.—Methods for the study of transport problems due to Maxwell and Chapman have been extended to the degenerate gases by applying the new statistics due to Fermi and Dirac. In order to apply this to an assembly of electrons and ions, Perisco's method has been adopted using known data for white dwarfs. Calculations are given for the companion of Sirius and ϵ_2-Eridani for different central temperatures. AUTHOR.

5139. Transport Phenomena in an Ionised Gas. R. C. Majumdar. *Zeits. f. Physik*, 91. 9–10. *pp.* 706–716, *Oct.* 14, 1934.—The problem of transport phenomena in a Maxwellian gas has already been treated in detail by Chapman and Enskog. Kothari has extended this problem to the Fermi-Dirac gas. All these works are based more or less on the classical methods and are not entirely free from objection. In this paper the problem is studied from the quantum-mechanical standpoint. In the first part the general method of dealing with such a problem is developed; the second part sets out formulæ for the transport phenomena; the last part extends these formulæ to astrophysics. The paper is mathematical throughout. R. L.

5140. Transport Phenomena in Einstein-Bose and Fermi-Dirac Gases. Part II. E. A. Uehling. *Phys. Rev.* 46. *pp.* 917–929, *Nov.* 15, 1934.—In this paper the general theory of transport phenomena in simple gases is concluded, and numerical values of the gas coefficients for heat conductivity and viscosity are obtained as a function of the temperature and density for the particular case of molecules acting as rigid elastic spheres. In the introduction will be found a qualitative discussion of the principal results obtained and an interpretation of these results according to elementary considerations. In Section 1 the method of solution of the integral equations with which the formal theory of Part I [see Abstract 2496 (1933)] was concluded is given together with the resulting general equations for the heat conductivity and viscosity coefficients. Since the integral equations can be solved only by a method of successive approximations, the expressions for the gas coefficients are in the form of infinite series the rapidity of convergence of which depends on a suitable choice of a complete set of auxiliary functions. In Section 2 all of the integrals appearing in the first two terms of the infinite series are evaluated. That only two terms are required is due to the fact that one is able to make an excellent choice of functions to represent the auxiliary set. In the evaluation of these integrals restriction is made in the application of the theory to small values of the degeneracy parameter A, since only terms in the zeroth and first power of A are retained. This restriction is only slightly greater than that imposed by the fundamental postulates of the general theory which restrict its applicability to moderately rare gases. In Section 3 the final equations for the gas coefficients are applied to gases consisting of molecules which interact quantum-mechanically as rigid elastic spheres of diameters and masses associated with the gases helium and hydrogen. AUTHOR.

5141. Molecular Heat at Constant Volume of Sodium Chloride and Certain Metals at High Temperatures. A. Eucken and W. Dannöhl. *Zeits. f. Elektrochem.* 40. *pp.* 789–792, *Nov.*, 1934.—In these calculations use is made of the assumption that the Gruneisen constant, $\gamma = 3\,\alpha\,V_0/C_v \cdot \chi$ (where α is the linear coefficient of expansion, V_0 the molecular volume, c_v the molecular heat at constant volume, and χ the compressibility) is, as a first approximation, independent of the temperature. Thus, the well-known expression connecting c_p and c_v leads to $c_p/c_v = 1 + \{3\,\gamma\,\alpha\,T/(1 + 3\alpha(T - T_0))\}$. Calculation with the help of the experimental data available gives, for sodium chloride, the maximum value of c_v as about 11·7 cal. at about 300° C., this value gradually decreasing to about 10 cal. at the melting point (800°). For silver, a similar variation with temperature is found, the maximum being 5·85 – 5·93 at about 400°, and the value at 900° being 5·60 – 5·85. With copper, lead, and nickel, however, maximum values exceeding the theoretical Dulong-Petit limiting value are obtained. An explanation for this behaviour is discussed. T. H. P.

5142. Thermodynamic Functions of Nitrous Oxide and Carbon Dioxide. L. S. Kassel. *Am. Chem. Soc., J.* 56. *pp.* 1838–1842, *Sept.*, 1934.—The free energy, heat content and specific heat of N_2O have been calculated up to 1500° K. The heat content and specific heat of CO_2 have been computed to 1000° K and the free energy to 1500° K; less accurate estimates have been made up to 3500° K. The equilibrium constants for the water-gas and producer-gas reactions have been tabulated from 300 to 3000° K, and that for the dissociation of CO_2 to 3500° K. AUTHOR

5143. Third Law of Thermodynamics. W. H. Rodebush. *J. Chem. Phys.* 2. *pp.* 668–670, *Oct.*, 1934.—The invariance of statistical weights requires that the entropy of any phase approach zero at 0° K.

The uncertainty principle, however, makes it impossible to define a state of absolute zero for a substance whose lowest energy states are closely spaced multiplets. AUTHOR.

5144. Entropy of Polyatomic Molecules. J. O. Halford. *J. Chem. Phys.* 2. *pp.* 694–696, *Oct.*, 1934.—A general expression for the entropy of the polyatomic molecule, rigid in the sense that only one form with a given set of moments of inertia is possible, is tested by comparison of calculated and experimental values. The results are satisfactory for molecules with as many as seven rotational degrees of freedom. AUTHOR.

5145. Isothermal Joule-Thomson Effect for Methane. A. Eucken and W. Berger. *Zeits. f. techn. Physik*, 15. 10. *pp.* 369–376, 1934.—The apparatus previously described [see Abstract 4432 (1932)], in which the magnitude of the Joule-Thomson effect is determined in terms of the amount of heat required to maintain the gas at a constant temperature, is improved and used for tests on methane. Results are given for this gas over the temperature range 20° C. to − 108° C. and for pressures ranging from 10 to 110 atmospheres. R. W. P.

5146. Joule-Thomson Effect in Argon. J. R. Roebuck and H. Osterberg. *Phys. Rev.* 46. *pp.* 785–790, *Nov.* 1, 1934.—The measurements employed the same apparatus as for helium and air [see Abstract 1657 (1934)]. Slight changes were made in the compressor and the purification system. The argon was of high purity except for 0·5 per cent of nitrogen. Clogging of the plug gave trouble in a limited part of the field. The vapour phase from Pyrofax gas makes an excellent low temperature bath liquid. The data for the isenthalpic curves are given in detail and plotted. The values of the Joule-Thomson coefficient, μ, over the field (− 150 to 300° C. and 1 to 200 atm.) are calculated, tabulated, and plotted as a function of temperature and pressure. The lower branch of the inversion curve ($\mu = 0$) falls within the low temperature range of these measurements. The trends of the Joule-Thomson effect in argon over the measured range of temperature and pressure are exceedingly like those in air and nitrogen. Lack of specific heat data prevents the calculation of other important thermodynamic coefficients. AUTHORS.

See also Abstracts 4834, 4886, 4887, 4889, 4983, 5117, 5121, 5122, 5133, 5147, 5192, 5200, 5201.

VAPOUR PRESSURE.

5147. Vapour Pressure of Calcium between 500 and 625° C. E. Rudberg. *Phys. Rev.* 46. *pp.* 763–767, *Nov.* 1, 1934.—The vapour pressure of solid calcium has been measured between 500 and 625° C., by the method of molecular effusion. The amount evaporated was determined by microtitration to better than 10^{-6} gm. The results are well represented by the empirical equation : $\log p$ (in mm.) $= 8{\cdot}15 - 9670/T$. The present values for the pressure are about ten times smaller than those previously reported by Pilling for the same temperatures. Since the specific heat of solid calcium is known as a function of T, the " vapour pressure constant," or " chemical constant," can be computed. The new pressure data lead to the correct value for this constant, but the old ones do not. For the heat of evaporation at $T = 0$ the value $4{\cdot}53 \times 10^4$ cal./mol. is obtained. AUTHOR.

See also Abstracts 5121, 5122.

ACOUSTICS.

5148. Longitudinal Waves in Cylinders of Liquid and in Tubes and Rods. G. S. Field. *Canad. J. of Research,* 11. *pp.* 254–263, *Sept.,* 1934.—A consideration of recently published results on the transmission of longitudinal waves in cylinders of liquid, tubes and rods shows that the first two cases give velocity-frequency curves which are quite similar to each other but different from that obtained with the third case. The reason for these results is discussed and is shown to be most probably the relative importance of shear forces in each case. The effect of viscosity on the phase velocity of longitudinal waves is considered, and it is shown that the classical method of introducing viscosity leads to erroneous results. AUTHOR.

5149. Acoustical Conductivities of Orifices. N. W. Robinson. *Phys. Soc., Proc.* 46. *pp.* 772–782, *Nov.* 1, 1934.—The acoustical impedance of a tube driven by a loud-speaker is adjusted so that the acoustical pressure at a fixed point is zero. One terminating impedance is the orifice whose conductivity is required together with an adjustable tube, and from well-known impedance relations the conductivity can be calculated. It is found that the conductivity C of a thin orifice of diameter d forming a constriction in a tube of diameter D is given by $C = 0{\cdot}787d/(1 - d/D)^{1{\cdot}895}$. When the orifices terminated the tube, the following relation was found to hold: $C = d(1 + d/D)^{1{\cdot}19}$. AUTHOR.

5150. Validity of the Raman-Banerjee Analysis of the Pianoforte Hammer Problem. K. V. Iyengar. *Indian Acad. Sci., Proc.* 1*A*. *pp.* 60–66, *July,* 1934.—The problem of determining the duration of contact of a hard hammer and a pianoforte string was solved by Raman and Banerjee [see Abstract 737 (1920)], but Kar and others have raised objections against the method [see Abstract 3272 (1928)]. In this paper it is shown that the method of analysis employed by the authors mentioned is correct and valid. G. E. A.

5151. Huson Ultrasonic Depth Sounder. G. S. Field. *Canad. J. of Research,* 11. *pp.* 406–408, *Sept.,* 1934.—Tests of the Huson ultrasonic depth-sounder (British Admiralty magnetostriction type) having a depth-range of 200 ft. is described. The tests were made in a tank 396 ft. long, 6 ft. deep and 9 ft. wide, the transmitter and receiver being mounted with the sound axis in a horizontal plane. Echoes were obtained from the ends of the tank and the distances varied by means of a movable carriage which supported the apparatus. A record is reproduced which shows good echoes at depths ranging from only a few feet up to 600 feet (by multiple echo). The experiments not only prove the value of the apparatus as a depth recorder in shallow water, but also show the practicability of testing such apparatus in a narrow tank. A. B. W.

5152. Interference of Ultrasonic Waves. C. Bachem and E. Hiedemann. *Zeits. f. Physik,* 91. 5–6. *pp.* 418–421, *Oct.* 5, 1934.—Previous work has shown that diffraction patterns can be obtained from stationary ultrasonic waves in a liquid and also, by using stroboscopic illumination, from progressive waves. The present paper is concerned with diffraction patterns produced by continuous illumination of a system which is not stationary in the ordinary sense, but is produced by oblique

reflection at a surface. The pattern obtained corresponds to the loci of amplitude point maxima of the superposed incident and reflected wave trains. A method of demonstrating these effects is described.
J. E. R. C.

5153. Acoustic Radiation Field of Piezoelectric Oscillator. Part II. L. V. King. *Canad. J. of Research,* 11. *pp.* 484–488, *Oct.,* 1934.—Numerical data on the distance of transmission of sound in sea water from a 10-in piezoelectric oscillator are discussed in the light of theoretical results obtained in a previous paper [see Abstract 4642 (1934)]. It is shown how by the principle of similitude the chart for transmission at optimum wave-length calculated for a 50-watt, 60 cm. oscillator can be used for a transmitter of any given diameter and output. A comparison with some experiments of Boyle's points to the fact that at supersonic frequencies, in the neighbourhood of 100,000 cycles, a considerably higher coefficient of viscosity than that obtained by flow methods must be used.
AUTHOR.

5154. Ultrasonic Absorption and Reflection Coefficients in Air and in Carbon Dioxide. R. W. Curtis. *Phys. Rev.* 46. *pp.* 811–815, *Nov.* 1, 1934.—Ultrasonic absorption coefficients in air and in CO_2 have been measured, as well as the coefficients of reflection in these gases at a solid boundary. In the frequency range between 88 and 1000 kc./sec. the absorption in air was found to increase with the square of the wave-length as required by classical theory, but for CO_2 the absorption constant of the classical theory rises to a sharp maximum at about 98 kc./sec. The reflection coefficient (brass reflector) was found to decrease with increasing frequency for both gases, the decrease being of the order of 20 % at the higher frequencies. Measurements on an impure sample of helium are included.
AUTHOR.

5155. Flames Sensitive to Sound. Part II. H. Zickendraht. *Helv. Phys. Acta.* 7. 7. *pp.* 773–803, 1934. *In German.*—Developing the technique for producing sensitive flames [see Abstract 682 (1933)], two types of burner are described and the flame characteristics considered. Observations are made of (1) the kind of gas used and the zones it forms on burning, (2) the velocity of flow in cold and burning gas, (3) the temperatures of different parts of the flame, (4) how the critical velocity and the viscosity of the gas are related. The different effects at various parts of the flame are examined by means of a slit and erecting prism, this shows that the sensitivity is due to a velocity change and is most marked in the blue part near the burner, where the velocity is highest. Loud sound shows a characteristic " one-sidedness " or " rectification," giving a strong and weak development of the flame surface per period. Combinational tones can be examined by the flame, and a platinum wire placed in it produces a roar. The experimental results are subjected to Bjerknes' hydrodynamic theory.
H. M. B.

5156. Hydrodynamic Mechanism of Sensitive Flames. V. Hardung. *Helv. Phys. Acta,* 7. 7. *pp.* 804–812, 1934. *In German.*—Two illuminating gas flames, issuing from the rounded ends of glass capillary tubes are placed close together and in such a position that both are between electrodes producing alternating electric fields. When the electric oscillations are in phase a mutual attraction is observed, and when the phases vary by 90° or 180° repulsion occurs. Bjerknes' theory of action of force at a distance in hydrodynamics [see Abstract 3836 (1934)] is used to account for the results. A single burner is used to find if the attraction by a condenser's negative electrode of a flame is due to ionisation, but negative results are obtained. H. M. B.

5157. Non-Linear Distortion of the Ear. G. v. Békésy. *Ann. d. Physik*, 20. 8. *pp.* 808–827, *Sept.*, 1934.—Experiments are made to determine which part of the ear is capable of producing overtones and difference tones. Results point to the fact that the overtones are almost certainly produced in the cochlea, possibly being due to eddies in the fluid. On the other hand difference tones appear in the middle ear, since their loudness is altered by difference of air pressure and muscle contraction in the ear passages. By a fatigue method, any possibility of overtones and difference tones being due to nerve disturbance is eliminated. H. M. B.

5158. Measurability of Auditory Sensation. F. H. Gage. *Roy. Soc., Proc.* 116*B. pp.* 103–119, *Oct.*, 1934.—Given three sounds, all pure tones of frequency 800 $\sim$, an observer was required to adjust the intensity of one until he judged it to bisect the loudness interval of the other two. The sounds were presented in order of increasing loudness, each being voiced for 1·25 sec. with a silent interval of 1·25 sec. between cycles. It was found that if loudnesses corresponding to intensities X_1 and X_5 are bisected to give X_3 and the two ranges X_1 to X_3, X_3 to X_5, further bisected to give X_2 and X_4 respectively, then the bisection of X_2 to X_4 gives $X_3{}^1$ which differs significantly from X_3. The conclusion is that a scale of auditory sensation based on the judgment of equal loudness intervals does not exist. [See also Abstract 5077 (1934).] W. S. S.

5159. Loudness, Pitch and Timbre of Musical Tones and Their Relation to Intensity, Frequency and Overtone Structure. H. Fletcher. *Acoustical Soc. of America, J.* 6. *pp.* 59–69, *Oct.*, 1934.—A single one-to-one relationship between loudness and intensity, pitch and frequency, and timbre and overtone structure does not exist. On the contrary, for example, the pitch of a musical tone depends not only on the fundamental frequency of vibration, but also on the overtone structure and the total sound intensity of the tone. Similarly with the other two subjective characteristics. Comparative tests were carried out by a group of observers to verify the above statements, and the results are given chiefly in graphs. As the frequency becomes lower than 500 or higher than 6000 there is an increasing departure from the one-to-one relationship between loudness and intensity. In the case in which a note has ten harmonics of equal intensity, the note is loudest when its frequency lies between 400 and 800. Practically all the loudness of the tones from piano strings of low pitch is due to the higher overtones. It is commonly assumed that the fundamental frequency of a tone determines its pitch. This is not generally true for pure or complex tones. Pure tones of constant frequency decrease in pitch as the loudness level increases. Some investigators have stated that, as the loudness level increases, tones having frequencies below about 2500 become lower in pitch, whilst those having frequencies above this value increase slightly in pitch. The author finds the greatest change in the octave below middle C (261). When the loudness of a pure tone of frequency 261 is increased from 40 db to 80 db, its pitch is lowered 0·11 octave or 1·3 semitones. The lowering in pitch of a complex tone with increase in loudness is less than that observed with pure tones. The question of change in timbre with change in intensity and pitch is also discussed. It is finally suggested that the resonators in the ear behave like stretched strings for frequencies below 2000, and like tuning forks for frequencies above that value. [See also Abstract 5386 (1933).] G. E. A.

5160. Vowel Theory. V. Engelhardt. *Naturwiss.* 22. *pp.* 690–693, *Oct.* 12, 1934.—A general discussion is given of various experimental results and their bearing on the absolute and relative theories of vowel sounds and on Köhler's octave law. [See also Abstract 1530 (1930).] A. W.

5161. Sound-Absorption Coefficients. V. L. Chrisler. *Acoustical Soc. of America, J.* 6. *p.* 115, *Oct.*, 1934.—The remarks of Norris [see Abstract 3839 (1934)] on the variation of the measured sound absorption coefficient of a material with the area of the specimen tested, are criticised on the grounds that (*a*) the " small area effect," and (*b*) the lack of uniformity in the sound field occasioned by the presence of a highly absorbing material in an otherwise highly reflecting test chamber, were overlooked. E. J. I.

5162. Acoustic Spectrometer. C. N. Hickman. *Acoustical Soc. of America, J.* 6. *pp.* 108–111, *Oct.*, 1934.—A series of tuned reeds are mounted so that they may be electromagnetically driven. Each reed carries a small concave mirror with which light from an illuminated slit is brought to a focus on a screen. These slit images are lined up in the order of the reed frequencies. When a current having a complex wave, such as the speech current from a microphone, is passed through the electromagnet, the reeds and in consequence the slit images on the screen will oscillate. The driving system and the reeds are so designed that the amplitude of oscillation of each image is proportional to the strength of the corresponding harmonic component in the driving current. Therefore, by observing or photographing the slit image amplitudes, the frequencies and the relative energy content of the components of a complex current may be determined. A spectrometer of this type covering a small frequency range (50 to 3109 ∼) was built for demonstration purposes. The range of such an instrument can be extended to higher and lower frequencies. AUTHOR.

5163. Sound Prism. O. H. Schuck. *I.R.E., Proc.* 22. *pp.* 1295–1311, *Nov.*, 1934.—The methods of sound analysis used at present are classified into those in which an analysing operation is performed upon a photographic record of the wave and those in which the wave is analysed as it is being produced. It is pointed out that the methods of the first group are very laborious and that those of the second group are slow in action, making them unsuitable for analysing sounds of relatively short duration such as those produced by persons. The need for a device to perform a rapid analysis is indicated. A new rapid acting heterodyne wave analyser called the " Sound Prism " is described and its operation is illustrated. The frequency spectrum is repeatedly traced on a translucent screen by a spot of light at such a rate that persistence of vision allows the eye to see the path of the spot as a steady line on the screen. The frequency spectrum is thus shown almost instantaneously so that changes in the spectrum may be continuously followed by the eye as the composition of the sound changes and the ear hears the change in quality. Sample records of analyses are given and a brief description of the work already done in the field of musical tone analysis is presented. The limitations of the sound prism in regard to resolution and speed are discussed and plans for further development are outlined. In an Appendix the problems concerned with the operation of the filter element at a high rate of frequency change are discussed. AUTHOR.

See also Abstracts 4837, 4838, 4864, 5105.

ELECTRICITY AND MAGNETISM.

ALTERNATING-CURRENT NETWORKS.

5164. A.C. Bridge for Audio-Frequency Determinations. G. D. Pegler. *Phys. Soc., Proc.* 46. *pp.* 783–789, *Nov.* 1, 1934.—When the secondary of an air-cored transformer, of inductance N, is closed through a total resistance Q, the effective resistance P′ and the effective inductance L′ of the primary are given by $(P' - P) = p^2M^2Q/(Q^2 + p^2N^2)$ and, $(L - L') = p^2M^2N/(Q^2 + p^2N^2)$, where M is the mutual inductance between primary and secondary, and p is 2π times the frequency. If Q is varied and p is kept cosntant, P′ becomes a maximum when $Q = pN$, and under this condition $(P' - P)_{\text{max.}} = pM^2/2N$, which is proportional to the frequency, while $(L - L')_{\text{max.}} = M^2/2N$ = a constant. The above equations form the basis of the proposed method of determination of frequency, the maximum change in P corresponding to any frequency being measured by the Owen a.c. bridge. The changes of resistance necessary to satisfy the third of the above equations may be effected with a single control, since both $(P' - P)_{\text{max.}}$ and the corresponding value of Q are proportional to the frequency. The change required to satisfy the last equation is effected by the mere closing of a switch. The effect of residuals is also discussed. AUTHOR.

5165. Balance-Detector for A.C. Bridges. C. R. Cosens. *Phys. Soc., Proc.* 46. *pp.* 818–823, *Nov.* 1, 1934.—A balanced valve arrangement with a portable d.c. galvanometer of pointer type is described for use as balance-detector in a.c. bridge work. Over an extensive range of frequencies its sensitivity is comparable to that of a vibration galvanometer or telephone. The direction of deflection shows which way the bridge must be adjusted to secure a balance as in the case of a d.c. bridge or electrodynamometer, but the false-zero effect found with the latter is absent. The arrangement could be adapted for use at radio frequencies. AUTHOR.

See also Abstracts 4990, 5254.

CONDUCTION AND DISCHARGE IN GASES.

5166. Concentration of Excited Atoms in Hg Discharge at High Pressures. V. Fabrikant and V. Pulwer. *Comptes Rendus de l'Acad. des Sciences, U.R.S.S.* 3. *pp.* 435–442, *Aug.* 21, 1934. *In German.*—By measuring the absorption and intensity of the visible Hg lines in the positive column of a high-pressure Hg discharge in a direction at right angles to the axis of a cylindrical tube and for various current strengths, the concentration of the Hg atoms in the 2^3P_0, 2^3P_1, 2^3P_2 and 2^1P_1 states is determined. In each case a linear increase with current strength is found. The concentrations do not agree with those derived from the Boltzmann distribution; other workers are in agreement on this point. H. J. H. S.

5167. Speed of Positive Ions in Nitrogen. J. H. Mitchell and K. E. W. Ridler. *Roy. Soc., Proc.* 146*A*. *pp.* 911–921, *Oct.* 15, 1934.—The mobility of the positive ions produced by glow discharge in pure nitrogen at a pressure of from 4 to 9 mm. has been found to be 2·67 cm./sec./volt/cm. Values of the mobilities of NH_3^+, Kr^+, Xe^+ and Hg^+ in nitrogen have also been obtained by adding small quantities of these substances to the gas. Of the 17 ions in nitrogen, which have now been studied in this laboratory, all lie on a smooth curve connecting the mobility of an ion with its mass, except those in pure nitrogen. Evidence is advanced for the view that the ions found in pure nitrogen are N_2^+ and that their mobility is 7·5 % less than that appropriate to their mass owing to the phenomenon of electron exchange. Further evidence of exchange is afforded by a study of the breakdown in the law which states that the speed of an ion is proportional to the field E and inversely proportional to the pressure p. A linear relation is found for seven ions between the critical value of E/p for breakdown and the reciprocal of the mass of the ion. Again the ion N_2^+ is anomalous. Examples are given of the suppression of ions of one kind and their replacement by ions of an impurity present in small concentration. AUTHORS.

5168. Ionic Mantle Effect in Gaseous Discharges. A. Güntherschulze. *Zeits. f. Physik*, 91. 11–12. *pp.* 724–726, *Oct.* 23, 1934.—The fact that in molecular gases the electrons the smaller is their velocity are the more strongly accumulated at neutral molecules and form negative ions, leads to the formation of a mantle of negative space charge round each gas discharge, which compresses the discharge to a more or less narrow tube even in wide vessels and at small pressures. Hence the current in molecular gases differs fundamentally from that in noble gases in which this phenomenon does not occur. The magnitude of this "ionic mantle effect" depends on (1) the current strength, (2) the gas pressure, (3) the nature of the gas. J. J. S.

5169. Corona Discharges in Various Gases. H. F. Boulind. *Phil. Mag.* 18. *pp.* 909–921, *Nov.*, 1934. *Supplement.*—Experiments were carried out on corona discharges in O_2, H_2, CO_2 and air. The apparatus used was similar to that described by Huxley, but with some modifications. Great care was taken to see that the gases used were pure, as it was found that the presence of minute quantities of impurity lowered the starting potentials appreciably. Curves are given showing the starting potentials in the different gases for various gas pressures with the central wire (*a*) positive and (*b*) negative. The results obtained are compared with those of Bruce, Penning and others. [See also Abstracts 4084 (1930), 1634 and 2779 (1931).] A. W.

5170. Dynamics of Gas Discharges. W. Druey. *Helv. Phys. Acta*, 7. 7. *pp.* 633–637, 1934. *In German.*—A discussion of experimental work by Valle, Steenbeck and Rogowski shows that the capacity of the discharge circuit plays an important part in the phenomena of gas discharges. Consideration of the mechanism of the production of ions shows that the development of the discharge in the transverse direction is of particular importance. Neglect of this by Valle results in wrong conclusions being drawn from his experiments. A. W.

5171. Current Distribution at the Kathode of a Glow Discharge. T. I. Câmpan. *Zeits. f. Physik*, 91. 1–2. *pp.* 111–123, *Sept.* 19, 1934.—Measurements were made of the number of positive ions reaching the kathode in a low-pressure discharge with normal kathode fall. Copper electrodes were used in H_2, O_2 and air and the perforated kathode method was employed. The kathode was so constructed that the collector space was completely separated from the discharge space except for the very small hole through the kathode. In order to prevent as far as possible the formation of space charges in the path of the positive ions passing through the hole in the kathode, the collector space was evacuated to a pressure 50 to 60 times smaller than that in the discharge space. Particular care was taken to free the walls and electrodes from gas. Under these conditions it was found that the number of positive ions arriving at the kathode and also the corresponding emission of secondary electrons was in good agreement both with the theoretical values and with the results obtained by Güntherschulze, using a thermal method, in conditions approximating to an anomalous discharge. The values obtained were: air 82 %, H_2 86 % and O_2 94 % of positive ions, the corresponding secondary emissions being 18 %, 14 % and 6 % respectively. The mean volt velocity of the positive ions reaching the kathode in these discharges was 40 to 60 volts in O_2 and 60 to 80 volts in H_2, the velocities observed covering the whole range from 0 to 200 volts. A. W.

5172. H.F. Glow Discharge. J. Thomson. *Phil. Mag.* 18. *pp.* 696–719, *Oct.*, 1934.—Discussion of previous work on h.f. discharges shows that investigations whose aim is the elucidation of the mechanism of the h.f. discharge are only satisfactory if (1) internal electrodes are used; (2) the gas is spectroscopically pure, and in particular is free from any trace of Hg vapour; (3) the distance between the electrodes is greater than $10^6/\nu$ cm., where ν is the frequency of the applied oscillations in cycles per sec.; (4) the dimensions of the tube are such that "wall effects" are negligible. Experiments are described on discharges in H_2, measurements being made of the striking potential (V_s) at different gas pressures (p) for three frequencies greater than 10^6/sec. A second set of measurements gave the striking potential at different gas pressures, using a steady potential between the electrodes. The results obtained show that, over a considerable part of the range of gas pressures used, V_s is a linear function of p. The gradient dV_s/dp in this region is independent of the frequency and is also the same for a d.c. discharge. The mean value of the gradient found from the experiments was 390 volts per mm. of mercury with electrodes 10 cm. apart. If the straight line $V_s = A + Bp$ is produced to cut the V_s axis, the value A of V is a function of the frequency. These results are discussed in their bearing on the theory of the h.f. and of the d.c. discharge. A. W.

5173. Gas Discharges with an Electrolyte as Kathode. W. Braunbek. *Zeits. f. Physik*, 91. 3–4. *pp.* 184–201, *Oct.* 2, 1934.—Glow discharges in oxygen (+ hydrogen) at 2 to 9 mm. Hg pressure are formed with a kathode consisting of an electrolyte. The electrolytes used were H_2SO_4 (of various concentration), NaOH and KOH. The minimum discharge potential is determined and compared with that obtained with a platinum kathode. The difference is found to be small, amounting to 30 volts at most. With an electrolyte as a kathode the value lies sometimes above and sometimes below that for platinum. This shows that the "metallic" nature of the kathode, that is, the presence of free electrons plays no essential part and that the electrons required to maintain the discharge can be obtained equally well from an electrolyte in so far as they do not come from the gas itself. H. L. B.

5174. Sparking Potentials at Low Pressures. A. J. Dempster. *Phys. Rev.* 46. *pp.* 728–730, *Oct.* 15, 1934.—At low pressures where only a few electrons produce ions, the number of electrons set free at the kathode by the impact of the positive ions formed in the gas is of primary importance in determining the minimum sparking potentials. Using the data for the efficiency of ionisation by electrons of various velocities, and recent observations of sparking potentials in air, we may deduce the number of electrons set free by the impact of a positive ion on a nickel kathode for any velocity. This number increases with the velocity of the ion from approximately 4 at 3000 volts to 85 at 30,000 volts. These numbers are much greater than those given by direct observations. The explanation is suggested that the spark originates at small spots where the emission is especially abundant, whereas the direct observations of secondary electron emission give an average value for the surface. AUTHOR.

5175. Mercury Arc at Liquid-Air Temperature. F. H. Newman. *Phil. Mag.* 18. *pp.* 607–610, *Oct.*, 1934.—Experiments with the mercury arc at liquid-air temperature are described. The mechanism of the arc with the kathode at a low temperature may be explained by the Langmuir theory of a very high electric field in the kathode neighbourhood. Between 90 and 100 % of the current at the kathode should, under such conditions, be carried by electrons. Any smaller fraction would require a positive ion current, which is not likely to be found. In addition, the fraction of the current carried by electrons probably depends on the vapour pressure. The discharge vessel was of pyrex glass with tungsten electrodes, a third electrode being used to pass a momentary discharge to start the arc. The kathode was a pool of mercury and the distance from the mercury surface to the lower extremity of the anode was 1·5 cm. 100 V, d.c., was applied between anode and kathode, and on passing a momentary discharge between the mercury and the third electrode, the arc started and was maintained indefinitely even when surrounded with liquid air, the mercury being solidified. The most interesting feature of the arc was the almost complete absence of luminosity, not only between the mercury and anode, but throughout the length of the tube immersed in liquid air, although the characteristic mercury radiation appeared in that part of the tube not immersed and extended along part of the connecting tubing. The anode temperature after starting the arc quickly rose almost to incandescence and then decreased, but still remained higher than that for the arc at ordinary temperatures. The small brilliant kathode spot observed in the mercury arc at ordinary temperatures also existed at the liquid-air temperature, but instead of moving over the mercury surface in an erratic manner it revolved at high speed round the solid mercury-glass junction. This revolution is attributed to the action of the magnetic field produced by the electron current from the kathode. The increased anode temperature is attributed to the bombardment by electrons from the kathode. The vapour pressure between the electrodes is exceedingly low and so the electrons lose little energy by molecular impacts, the pressure being of the order of 10^{-4} mm. of mercury. It appears probable that a stream of mercury vapour is continuously emitted from the kathode surface, even when this is in the solid state. The experiments show that the current is, under the conditions obtaining, carried almost entirely by electrons. A. W.

5176. Theory of Positive Column with Moving Striations. M. J. Druyvesteyn. *Physica,* 1. *pp.* 1003–1006, *Oct.–Nov.*, 1934. *In German.*—An error in a formula of a former publication [see Abstract 2132 (1934)] on the positive column with moving striations is rectified, the main results of the calculation remaining unaltered. The final-velocity distribution of electrons in a homogeneous electric field is calculated in a simple manner, in the case that the electrons only make elastic collisions with the gas atoms. AUTHOR.

5177. Explanation of the Zero Normal Gradient of the Rare Gases on the Basis of Diffusion. G. Zimmermann. *Zeits. f. Physik*, 91. 11–12. *pp.* 767–774, *Oct.* 23, 1934.—The zero normal gradient of the electrical discharge through the rare gases A and Ne, found by Güntherschultze and Keller [see Abstract 5200 (1932)] is shown to be explicable on the basis of electron diffusion from the kathode to the anode. The calculation indicates that, using Kenty's value [see Abstract 829 (1929)] of 2×10^{-10} for the recombination coefficient of A, the observed current could be maintained by diffusion up to a pressure of 70 mm. of Hg. For He and Ne, this pressure limit is still higher if the same recombination coefficient is used. The theory is applied to other gases and the exactness of the calculations is discussed. F. C. C.

5178. Ionisation Potentials and Probabilities for the Formation of Multiply Charged Ions in the Alkali Vapours and in Krypton and Xenon. J. T. Tate and P. T. Smith. *Phys. Rev.* 46. *pp.* 773–776, *Nov.* 1, 1934.—A mass-spectrograph analysis has been made of the ions formed by electron impact in Na, K, Rb. Cs vapours and in Kr and Xe. The electron energy varied from zero to 700 electron-volts. Multiply charged ions were formed in all cases when the electron energy was sufficiently high. The ionisation potentials for the various ions are given in a table. In general the curves showing likelihood of formation of these ions as a function of electron energy are of the usual shape. In the cases of K^+, Rb^+, Cs^+ and Cs^{2+} there are evidences of additional mechanisms of formation which appear at the following potentials: for K^+ at 15·5 and 150 volts; for Rb^+ at 12·5; for Cs^+ at 10, 17·5, and 60 volts; for Cs^{2+} at 80 volts. AUTHORS.

5179. External Recording with the Kathode-Ray Oscillograph. E. W. Freisewinkel. *Arch. f. Elektrot.* 28. *pp.* 602–611, *Oct.* 20, 1934.—An attachment has been constructed for recording externally with the kathode-ray oscillograph by the contact print method at a maximum writing speed of about 2000 km. per sec. A mica fluorescent screen 4 cm. × 8 cm. × 1 mm. thick is mounted at the end of the horizontal kathode-ray tube and supported by a grid of 1 cm. mesh. The records are taken on ordinary roll films which press against the mica screen and can accommodate up to 35 records on one reel. E. W.

5180. Gas-Focused Kathode-Ray Oscillographs. J. T. MacGregor-Morris and J. A. Henley, *I.E.E., J.* 75. *pp.* 487–496, *Oct.*, 1934.—A brief survey is given of recent modifications in the construction of gas-focussed kathode-ray oscillographs, and some of the resulting improvements in performance are described. Recent work of other investigators which has a direct bearing on the subject matter of the present paper is summarised. A comparison is made of the electrostatic sensitivities obtained from simple electron dynamics and that found by experiment for two focusing gases, argon and helium; an explanation is advanced for the results obtained. The phenomenon of origin distortion is next considered, and results are given showing its variation with gas pressure for hydrogen, and with the frequency of the deflecting voltage between 0 and $1{\cdot}25 \times 10^6 \sim$ for hydrogen, helium, and argon, as focusing gases. The dependence of gas focusing on the transverse speed of the electron beam is discussed, and photographs are given which demonstrate this dependence in the cases of hydrogen, helium, and argon. The paper concludes by indicating the practical importance of the results given. AUTHORS.

5181. Double-Wave Device for Use with a Kathode-Ray Oscillograph. I. B. Davidson. *Journ. Sci. Instruments,* 11. *pp.* 359–361, *Nov.,* 1934.—The paper describes a valve circuit for use in conjunction with a linear time-base to present, for simultaneous observation, two waveforms of periodic quantities on the screen of a sealed-off type oscillograph. AUTHOR.

5182. Timing Method for Kathode-Ray Oscillographs. E. V. Sundt and G. H. Fett. *Rev. Sci. Instruments,* 5. *pp.* 402–404, *Nov.,* 1934.—A timing method is described for use with kathode-ray oscillographs. The method resembles that previously described by Richardson [see Abstract 1359B (1933)] in that periodic breaks are introduced in the screen image, but while Richardson de-focused the beam periodically, in the present method the beam is cut off periodically by the application of a small a.c. potential to the grid of the Type 905 kathode-ray tube used. Typical oscillograms of the time-voltage-current characteristics of instrument fuses and inductive circuits are given, the time markings being derived from a synchronous motor operated from 60-cycle mains and carrying on its shaft an iron toothed wheel arranged so that the teeth passed close to the poles of a U-shaped permanent magnet carrying suitable windings. A. W.

5183. Electron-Lens Formulæ. L. H. Bedford. *Phys. Soc., Proc.* 46. *pp.* 882–888, *Nov.* 1, 1934.—A simple proof of the Davisson electron-lens formulæ [*Phys. Rev.* **42**. *p.* 580, 1932] is developed, and their proper interpretation is given for the important case of a lens system with differing entrance and emergence velocities. AUTHOR.

5184. Chain Reactions in the Oxidation of Hydrogen in the Positive Column. A. K. Brewer and P. D. Kueck. *J. Phys. Chem.* 38. *pp.* 889–900, *Oct.,* 1934.—In contrast to a fixed ratio of $M/H_2^+ = 2$ in the negative glow, the rate in the positive column increases with both current and pressure until the ignition point is reached. The rate of reaction is accelerated by added gases in accordance with their ability to retard diffusion, the effect being almost the opposite to that in the negative glow. The rate is retarded by the presence of walls and accelerated by temperature. The results are interpreted as indicating the presence of reaction chains in the positive column but not in the negative glow. Reasons are advanced to show that the chains must be of the cluster type and cannot consist of atoms or radicals. The mechanism, as well as the factors influencing the cluster type of chains, is discussed. AUTHORS.

5185. Purification of Inert Gas with Mischmetal. C. C. van Voorhis, A. G. Shenstone and E. W. Pike. *Rev. Sci. Instruments,* 5. *pp.* 367–368, *Oct.,* 1934.—Details are given of a process whereby an inert gas can be brought to a high degree of purity by exposing it to an electric discharge between electrodes of which the kathode is made of mischmetal. F. J. W.

5186. Dissociation of Nitrous Oxide in the H.F. Glow Discharge. E. A. Stewardson. *Faraday Soc., Trans.* 30. *pp.* 1018–1027, *Nov.,* 1934.—A method is described whereby the relatively rapid dissociations produced in gaseous compounds by electric discharges at pressures of the order of 1 mm. may be conveniently measured, and the results are given of some experiments on N_2O subjected to a h.f. glow discharge. It is shown, in agreement with other observers, that for sufficiently intense fields there is a range of pressures over which the dissociation appears to be unimolecular, but in weak fields the initial rate of dissociation becomes approximately independent of the initial pressure. It is further shown that in the non-unimolecular type of dissociation, any individual dissociation still approximates closely to a unimolecular law, but that the velocity constant is pressure dependent. The relation between the two dissociation types is shown by a series of curves relating the half value period to the initial pressure for different potentials. AUTHOR.

5187. Electronic Ionisation Coefficient for Nitrogen at Low Pressures. R. Hellman. *Zeits. f. Physik*, 91. 7–8. *pp.* 556–568, *Oct.* 12, 1934.—An apparatus for the measurement of the Townsend electronic ionisation coefficient α is described. The method involves the measurement of the variation of ionisation current from electrons produced by ultra-violet light, with electrode separation, gas pressure and field strength being kept constant. Down to 3·5 mm. Hg pressure the values of the function $\alpha/p = f(E/p)$ are in substantial agreement with those of previous authors. At lower pressures the ionisation is greater than the predicted value. The formula, at pressures above 3·5 mm. Hg has the form $\alpha/p = c_1 e^{-c_2 p/E}$, the numerical values of the constants c_1 and c_2 being of the order of magnitude predicted by the theory. At lower pressures c_1 and c_2 can no longer be regarded as constant. This latter result is particularly significant, as previously, in the consideration of gas discharges, c_1 and c_2 have been assumed to be constant. In such considerations it is therefore necessary to estimate and correct for the variation of ionisation with pressure. J. E. R.

5188. Improvements to the "Scale of Two" Thyratron Counter. W. B. Lewis. *Cambridge Phil. Soc., Proc.* 30. *pp.* 543–548, *Oct.* 30, 1934.—The "scale of two" thyratron counter of Wynn-Williams [see Abstract 3950 (1932)] is improved to reduce the time of resolution. The change in the circuit consists in the use of small condensers (0·0015 μF) cross connected between the grids and anodes of the pair of thyratrons; the extinguishing condenser connected between the anodes is reduced to 0·02 μF. A valve amplifying stage is introduced to pass the impulses from the modified circuit of the first pair to the second pair of thyratrons. A counting speed of 8000 random impulses per minute with a probable loss of only 2 % is obtained. F. C. C.

5189. Measurement of Small Ionisation Currents. J. C. Jacobsen. *Zeits. f. Physik*, 91. 3–4. *pp.* 167–168, *Oct.* 2, 1934.—A simple automatically compensated electrometer system for the measurement of small ionisation currents is described. The ionisation current charges up a Compton electrometer and a fixed condenser. Light from the electrometer mirror falls between two photoelectric cells wired "back to back," and connected to the grid of an amplifying valve, the anode circuit of which is connected to the fixed condenser. Variations in the potential of the electrometer affect one or other of the photoelectric cells and the variation is compensated by the change produced in the anode current. The rate of change of the anode current therefore gives a measure of the ionisation current. J. E. R.

5190. Amplifier Systems for the Measurement of Ionisation by Single Particles. J. R. Dunning. *Rev. Sci. Instruments*, 5. *pp.* 387–394, *Nov.*, 1934.—The choice of amplifier systems for the measurement of ionisation produced by single particles is discussed with respect to the design and arrangement of the (*a*) ionisation chamber, (*b*) first valve, (*c*) amplifier and output circuits, (*d*) thyratron recorders, (*e*) power supplies, (*f*) constant high voltage supplies, (*g*) filament voltage supplies, (*h*) voltage control. F. C. C.

See also Abstracts 4788, 4792, 5015, 5035, 5139, 5209, 5211.

CONDUCTION IN SOLIDS AND LIQUIDS.

5191. Electronic and Lattice Conduction of Heat in Metals. E. Grüneisen and H. Reddemann. *Ann. d. Physik*, 20. 8. *pp.* 843–877, *Sept.*, 1934.—The thermal and electrical resistivities of pure Ag, Cu and Pd and of alloys of Au-Ag, Au-Cu, Cu-Pd and Au-Pd have been determined at − 183, − 195, and − 251° C. The law of linear isotherms (thermal resistivity a linear function of electrical resistivity for different specimens of each metal at the same temperature), and therefore the Norbury relation for thermal resistivity holds good in general; but as the metal becomes very impure, and the lattice distortion becomes large, the thermal resistivity increases less rapidly than the electrical. This departure from linearity occurs more readily the lower the temperature. The isothermal thermal resistivity-electrical resistivity curve for a complete binary series of mixed crystals is a line which at the higher resistivities bends towards the electrical resistivity axis and expands into a loop. As the temperature decreases the loop becomes larger until the divergence commences in the low resistivity region. In analysing the results the thermal conductivity is considered to be due to a combination of electronic and lattice conduction. For most pure metals at normal temperatures the lattice conduction is much less than that due to the electrons, but as the temperature decreases the contribution of the lattice becomes relatively more important, which accounts for the greater deviation from the law of linear isotherms at low temperatures. It would appear further, that at the lowest temperature the lattice conduction becomes modified by the electronic conduction, as has been suggested by Peierls, and the actual conductivity is not the direct sum of the two components. R. W. P.

5192. Electronic Structure of Metals. J. C. Slater. *Rev. Modern Physics*, 6. *pp.* 209–280, *Oct.*, 1934.—The recent theoretical developments concerning the electronic structure of metals are described in considerable detail. Particular attention is given to the manner in which each theory explains electrical conductivity, and expressions are also derived for the total energy upon which depend the cohesion, compressibility, heat of vaporisation, etc. The theories dealt with commence with the original classical theory of Lorentz, and Sommerfeld's subsequent application of Fermi statistics to this theory. Then follows the application of Fermi statistics to a free electron model in which the electron is first assumed to move according to classical mechanics in a field-free space. This gives a crude representation agreeing qualitatively with the truth, but is very incomplete and suggests no explanation for ferromagnetism. The introduction of a periodic field leads to the Thomas-Fermi model for which the total energy behaves much more like that of a real metal. It is obvious, however, that the statistical method which does not take account of electron shells and the periodic properties of the elements cannot give a very exact representation. The electrons are finally considered to move according to wave mechanics, it being assumed as a first approximation that each electron moves in an averaged out field and not in that of all other electrons. The problem is thus reduced to a set of problems, one for each electron. Wave functions are computed and discussed, metallic energy levels introduced, and coordinate and momentum eigenfunctions derived. An outline is given of the method used to determine the kinetic and potential energies of a metal, and it is shown that the total energy has a minimum at some equilibrium distance. Ferromagnetism can be explained by the existence of only partially filled shells and it is concluded that this method, which deals with one-electron functions, and discusses separately the kinetic and potential energy by the use of the momentum and coordinate eigenfunctions and the virial theorem, presents the most helpful method of attack at present available for the examination of the structure of solids. A Bibliography containing over one hundred references is appended. R. W. P.

5193. Momentum of Conducting Electrons. E. Patai. *Phys. Zeits.* 35. *p.* 837, *Oct.* 15, 1934.—It is suggested that the momentum of the conducting electrons might be determined from the torsional displacement which should result when the supraconducting current suddenly ceases as the temperature of a suspended metallic ring is raised above the supraconducting point. R. W. P.

5194. Ampère's Elements of Current and Modern Physics. F. Guery. *Soc. Franç. Élect., Bull.* 4. *pp.* 1041–1054, *Oct.*, 1934.—Modern physics attributes the electric current to a circulation of elementary charges. It attributes also the interatomic or intermolecular forces, cohesion amongst others, to electric or electromagnetic actions between elementary charges which may be the constituent elements of matter. In this order of ideas Ampère's elements of current, which in his time were only mathematical fictions, acquire a precise physical significance, and the effects of currents can be interpreted by a modification of electric force due to the motion of charges. The author develops these views and indicates the modifications which must be made in the formula of the mutual energy between elementary charges in order to take account of their state of motion. These modifications explain not only the actions between circuits traversed by currents, but also those of the electric and magnetic fields on the electron in motion. They permit besides of the interpretation of the Lorentz contraction which constitutes one of the bases of the theory of restricted relativity. J. J. S.

5195. Resistance Standards and Atmospheric Humidity. M. Romanowski. *Comptes Rendus,* 199. *pp.* 638–639, *Oct.* 1, 1934.—Resistance standards which are not hermetically sealed are apt to be affected in value by changes of atmospheric humidity, and should therefore be kept in an atmosphere of constant humidity. A relative humidity of 50 % at 20° C. has been adopted for this purpose at the International Bureau of Weights and Measures. It is obtained by the use of aqueous sulphuric acid solution of concentration 43·2 % H_2SO_4 by weight (density 1·336 at 20° C.) as absorbing agent. L. H.

5196. Iron-Hydrogen Resistors. W. Kleinschmidt. *Zeits. f. techn. Physik,* 15. 10. *pp.* 385–386, 1934.—Examination was made of the preliminary process of insertion of iron-hydrogen resistances, that is the transient course of the rise of current on switching on the current through the resistance. Observations were made with and without an additional resistance of uranium oxide. The course of the current after making contact is shown on diagrams. J. J. S.

5197. Semi-Conductors. G. Déchêne. *Ann. de Physique,* 2. *pp.* 241–345, *Oct.*, 1934.—The properties of semi-conductors are studied in detail and under widely differing conditions. Substances such as yellow oxide of mercury, sodium carbonate, zinc oxide and lead chloride are used. The author attempts to complete the previous experimental work on the subject and to obtain a satisfactory explanation of the phenomena observed. The exposition is divided into two parts. The first consists of a detailed investigation of the discontinuities of potential produced when the surface of separation of a semi-conductor and a metallic electrode is traversed by an electric current, and of the effects of various physical conditions such as time, temperature, illumination of the electrodes and pressure on the semi-conductor. Voltages between a fraction of a volt and 20,000 volts are used. The discontinuity of potential is attributed to the formation of a space charge in a thin layer of the semi-conductor and the hypothesis developed gives a satisfactory explanation of the observed effects. A.c. measurements show that the contact has a capacity from the value of which the order of magnitude of the layer in which the rapid variations of potential are produced is calculated to be about 10^{-2} or 10^{-3} cm. The second part of the work deals with an investigation of the properties of the absorbable radiation produced at high voltages when the electrode is in the form of a grid. Various hypotheses are reviewed and arguments are advanced in favour of the one which suggests that the origin of the radiation is in the air and not in the semi-conductor. The study of the radiation by the ionisation method and its analysis in the vacuum spectrograph give concordant results. The radiation is found to be complex and contains radiations whose wave-length is between some ten and some hundreds of Ångström units. R. L.

5198. Electrical Resistivities of Single and Optically Mosaic Zinc Crystals. W. J. Poppy. *Phys. Rev.* 46. *pp.* 815–821, *Nov.* 1, 1934. —The Voigt-Thomson symmetry relation is accurately checked for two sets of strain-free zinc single crystals made from two lots of Evanwall zinc. The principal electrical resistivities in micro-ohms/cm.^{3} are: $\rho_0 = 6{\cdot}218$, $\rho_{90} = 5{\cdot}882$ with the ratio, $\rho_0/\rho_{90} = 1{\cdot}0554$ for one lot (E.W.R.) and $\rho_0 = 6{\cdot}161$, $\rho_{90} = 5{\cdot}842$, $\rho_0/\rho_{90} = 1,{\cdot}0548$ for the other (E.W.B.). The resistivity is changed by slight strains due to application of micrometer calipers to the crystals, the change being a decrease in four cases out of eleven. Severe strains, in general, increase the resistivity. The effects of repeated anneals on strained crystals are complex, the most important conclusion being that high temperature anneals (at about 400° C.) are not effective in restoring the initial resistivity of all orientations. A final low temperature anneal (at 190° C. for 84 hours) is, however, completely effective. Optically mosaic specimens have abnormal resistivities, either greater or less than single crystals of the same orientation. Such specimens are very strain-sensitive, the resistivity rising markedly after a strain and falling for a subsequent anneal. This effect may be repeated several times on a specimen. The ambiguous results of previous observers may be explained either as strain effects or as due to the presence of optically mosaic specimens. AUTHOR.

5199. Gold-Chromium Resistance Alloys. J. L. Thomas. *Bureau of Standards, J. of Research,* 13. *pp.* 681–688, *Nov.*, 1934.—The addition of from 1·6 to 2·4 % or more of Cr to Au produces alloys having very small temperature coefficients of electrical resistance. In particular, 2·1% of Cr in Au gives an alloy whose resistance has been made independent of temperature, to a few parts in 10 million, in at least the interval 20° to 30° C. These alloys are also exceptionally stable in resistance. They, however, have a thermoelectric power against copper which is 3 or 4 times as large as that of manganin. The preparation and heat treatment of some of these alloys are described. AUTHOR.

5200. **Electrical Conductivity and Phase Diagram of Binary Alloys. System Lithium-Lead. G. Grube and H. Klaiber.** *Zeits. f. Elektrochem.* 40. *pp.* 745–754, *Nov.*, 1934.—The full range of Li-Pb alloys is investigated by the method of thermal analysis and study of the temperature-electrical resistance curves for the solids. The results are embodied in a complete phase diagram for the system. The investigation proves the existence of the intermetallic compounds LiPb, Li_5Pb_2, Li_3Pb, Li_7Pb_2, and Li_4Pb, of which only LiPb (melting point 482° C.) and Li_7Pb_2 (726° C.) melt unchanged. The compound LiPb occurs in two forms with a transition point at 214° C. The following mixed crystals are formed: Pb — LiPb, LiPb — Li_5Pb_2, and Li_7Pb_2 — Li. L. A. W.

5201. **Electrical Conductivity and Phase Diagram of Binary Alloys. System Lithium-Tin. G. Grube and E. Meyer.** *Zeits. f. Elektrochem.* 40. *pp.* 771–777, *Nov.*, 1934.—The full range of Li-Sn alloys is investigated by the method of thermal analysis and study of the temperature-electrical resistance curves of the solids. The results are embodied in a complete phase diagram for the system. The investigation proves the existence of the intermetallic compounds $LiSn_2$, LiSn, Li_2Sn, Li_5Sn_2, Li_7Sn_2, and Li_4Sn, of which LiSn (melting point 485° C.), Li_7Sn_2 (783° C.), and Li_4Sn (765° C.) melt without change. The compound Li_7Sn_2 forms mixed crystals with excess Sn. L. A. W.

5202. **Electrical Conductivity of Strong Electrolytes and Its Variation with Temperature. C. J. B. Clews.** *Phys. Soc., Proc.* 46. *pp.* 764–771, *Nov.* 1, 1934.—The electrolytic conductances of potassium sulphate, potassium nitrate and sodium sulphate have been measured over a wide temperature range, by means of an accurate bridge method in which a.c. is supplied by a valve oscillatory circuit. The sensitivity and accuracy of the method have been increased by using a suitably designed amplifying circuit, and special attention has been paid to the very important question of temperature-control during the experiments. AUTHOR.

5203. **Resistivity of Sulphuric-Acid Solutions and its Relation to Viscosity and Temperature. G. W. Vinal and D. N. Craig.** *Bureau of Standards, J. of Research,* 13. *pp.* 689–697, *Nov.*, 1934.—The resistivity of sulphuric-acid solutions ranging from 15 to 45 % acid has been measured at temperatures of + 30 to − 40° C., except as the measurements of some solutions were limited by their freezing points. The resistivity of these solutions at 0° C. is about 1·7 times that at + 30° C., but at − 40° C. the resistivity is 5·5 times as great. The composition of solutions having minimum resistivity (maximum conducitity) was found to depend on the temperature. At 18° C. the solution having minimum resistivity was found to be 30·4 %, as previously determined by Kohlrausch, but at − 25° C. the solution of minimum resistivity contains only 26·5 % acid. Values of resistivity for each interval of 5 % in composition and 5° C. in temperature are given. An empirical relation between resistivity, kinematic viscosity and absolute temperature was found to hold for concentrated solutions over a temperature range from + 30 to − 40° C. AUTHORS.

5204. **Electrical Conductivity of Amber at Different Pressures. F. Seidl.** *Zeits. f. Physik,* 91. 5–6. *pp.* 318–322, *Oct.* 5, 1934.—In previous experiments on the effect of temperature and field strength on the conductivity of amber an anomalous current reversal was found for constant

external potential [see Abstract 4503 (1932)]. In a subsequent publication by Goldhammer [see Abstract 4625 (1933)] it was shown that the results of conductivity measurements with amber were very susceptible to the effect of surface condition and suggested that the anomalous current reversal could be explained in this manner. In the present series of experiments the conductivity of amber is measured at atmospheric pressure and in a high vacuum under conditions which exclude the possibility of variations in surface effects. No anomalous current reversal is observed. The results of the conductivity measurements are tabulated.
J. E. K.

See also Abstracts 4848, 4994, 5006, 5189, 5208, 5211, 5212, 5255, 5267.

DIELECTRICS AND CAPACITANCE.

5205. Effect of the Solvent in Dipole Moment Measurements. Moment of Ethylene Bromide. M. A. G. Rau and B. N. Narayanaswamy. *Indian Acad. Sci., Proc.* 1*A*. *pp.* 14–27, *July*, 1934.—The polarisations of $C_2H_4Br_2$ have been measured in four solvents, benzene, toluene, CCl_4 and cyclohexane at infinite dilution and over the temperature range 10° to 40° C. The moments calculated from the polarisation values differ considerably from solvent to solvent, and show an increase of about $0 \cdot 08 \times 10^{-18}$ e.s.u. over the temperature range investigated. With the help of recent data for the magnitude and direction of the group moment $-CH_2Br$, the potential energies between the rotating parts of the $C_2H_4Br_2$ in the different solvents have been calculated, and compared with the values obtained by recalculating from the measurements hitherto reported for $C_2H_4Br_2$ and also for $C_2H_4Cl_2$ and C_2H_4ClBr. The characteristic effect of benzene on the moment of $C_2H_4Br_2$ is probably best explained on the basis of the hemispherical domes of influence around the benzene ring postulated by E. Mack, Jr. [see Abstract 4090 (1932)] and having their origin in the oscillation of the double bonds in the benzene molecule.
AUTHORS.

5206. Dipole Moment of S-Trinitrobenzene. G. Briegleb and J. Kambeitz. *Zeits. f. phys. Chem.* 27. *Abt.B.* 1–2. *pp.* 11–14, 1934.—The dipole moment of *s*-trinitrobenzene in benzene has been determined and the ascertained value compared with existing data. Values are given for P_1, P_{12} and P_e. From these and the effect of atomic polarisation the value $0 \cdot 41 \times 10^{-18}$ is derived. W. R. A.

5207. Dielectric Properties of Aryl-halogeno-acetylenes. C. J. Wilson and H. H. Wenzke. *Am. Chem. Soc., J.* 56. *pp.* 2025–2027, *Oct.*, 1934.—The dipole moments of a number of aryl-halogeno-acetylenes have been measured. It has been shown that the carbon to iodine moment in aryliodoacetylenes has the plus end toward the iodine atom. It has been shown that the carbon to bromine moment and the carbon to chlorine moment in aryl-halogeno-acetylenes is less than the corresponding carbon to halogen moments in substituted benzenes. The bromine and chlorine are " negative " but much less so than in the more saturated derivatives such as those of the paraffins, ethylenes and benzenes. The conclusions reached by electric moment measurements are in agreement with those reached by less direct chemical evidence. AUTHORS.

5208. Flow of Electrons in Insulators in Fields of Extreme Intensity. A. Güntherschulze and H. Betz. *Zeits. f. Physik*, 91. 1–2. *pp.* 70–96, *Sept.* 19, 1934.—An investigation is made of the flow of electrons in oxide layers, extremely thin and homogeneous and highly insulating, which have been deposited on Al, Bi, Nb, Ta, Ti and Ce electrolytically. A region is chosen in which there is no simultaneous flow of ions. The current-potential curves for different forming potentials are given. In the case of Al the curves are exponential, at higher forming potentials they represent a power relationship. In the case of Bi, Nb and Ta the reverse is the case. In Ti and Ce only a power relationship is found. On short-circuiting the oxide layers considerable quantities of electricity escape from them, which had been present in them as space-charges. Hints are given of a theory for these results. H. L. B.

5209. Measurement of Electrostriction in Gases. J. Jaumann and V. Stipa. *Zeits. f. Physik*, 91. 9–10. *pp.* 685–705, *Oct.* 14, 1934.—Details are given of an apparatus and experimental procedure for measuring electrostriction. Gases are subjected to an a.c. field of 50 ~ and the reduction of gas pressure due to electrostriction measured by means of a compensating method. In this way the effect of slow temperature changes and insulation errors which limited the accuracy of former methods employing static fields, is avoided. The measured values are reproducible to within 1 %. The accuracy of measurement increases as the third power of the pressure; highly compressible gases are therefore employed. The dielectric constant calculated from the Lippmann-Gans formula agrees well with the values obtained by capacity measurements cited in the literature, and so confirm this formula for low pressures (1–10 atmospheres) and to within 75 % of the breakdown field strength for all the gases studied. At the higher pressures (over 10 atmospheres) O_2 and N_2 and especially CO_2 and SO_2, show a marked increase of electrostriction which corresponds to the increase of dielectric constant. On the other hand the gases H_2, He and A are completely normal. R. L.

5210. Effect of a Magnetic Field on the Dielectric Constants of Liquids. A. Piekara and M. Schérer. *Comptes Rendus*, 199. *pp.* 840–843, *Oct.* 29, 1934.—The hypothesis of molecular orientation by means of which electric and magnetic birefringence has been explained leads one to expect a change in the dielectric constant of bodies in a magnetic field. Up till now experiments have always given negative results except for certain liquid crystals. According to the old quantum theory this effect is large, but the new quantum mechanics has re-established the validity of the results of classical theory. These indicate that for a paramagnetic gas in a field of 50,000 gauss a change of dielectric constant of the order of 10^{-6} is to be expected, but no prediction is given for diamagnetic liquids. The authors have employed fields of 51,000 gauss and have taken precautions to eliminate errors. Eight organic liquids are examined and in each instance an increase of dielectric constant is found. The effect decreases rapidly with decreasing magnetic field and becomes negligible below 25,000 gauss. From their observations and the fact that the effect obtained is 1000 times greater than that predicted for gases, the authors suggest that molecular orientation may be accompanied by another phenomenon connected with the frequency of oscillation of the molecules. Further experiments are to be undertaken. R. L.

5211. Bibliography of Dielectric Measurements. Winifried O. Schumann. *Die Physik*, 2. 4. *pp.* 153–166, 1934.—An annotated Bibliography of the abstracts, published in the *Physikalische Berichte* from 1931 to 1934, of papers reporting measurements of dielectric constant, dielectric loss, conductance, breakdown, Lichtenberg figures, and piezo electric effects for solids, liquids and gases. W. H. W.

5212. Dielectric Losses in Crystals. N. Bogorodizky and W. Malyschew. *Arch. f. Elektrot.* 28. *pp.* 644–653, *Oct.* 20, 1934.—The d.c. conductivity of crystalline dielectrics such as rock-salt, quartz and mica is compared with the a.c. conductivity calculated from measurements of dielectric constant and power factor at 50 and $2 \times 10^6 \sim$. For symmetrical crystals (rock-salt), the d.c. and a.c. conductivities are identical over the temperature range 40–400° C. In the case of unsymmetrical crystals (mica and quartz), the d.c. and a.c. conductivities are not equal, the a.c. conductivity being much the greater, although at temperatures greater than 200° C.–300° C. the conductivities become more nearly equal. For quartz cut perpendicular to the optical axis the ratio of a.c. to d.c. conductivity is greater than for quartz parallel to the optical axis. The relation between d.c. conductivity (σ) and temperature (T) is expressed in all cases in the form: $\sigma = Be^{-a/T}$. The a.c. conductivity also satisfies this relation; for rock-salt at all temperatures, but for mica and quartz only at high temperatures. E. R.

5213. Measurement of Very Small Changes of Capacitance. W. Bünger. *Zeits. f. Physik.* 91. 9–10. *pp.* 679–684, *Oct.* 14, 1934.—A radio-frequency bridge method. The bridge consists of four capacitance arms. The coupling between it and the oscillator is capacitive, and the phase-adjustment required for balance is obtained by adjustment of this coupling, while the magnitude-adjustment is made in the usual way. The detector comprises a two-stage screen-grid amplifier, rectifier, and sensitive mirror-galvanometer, the deflection of which indicates the changes of capacitance occurring in one arm of the bridge. Protection against mechanical vibration is required. Photographic records of the deflection show that the steadiness and sensitivity are such that capacitance changes $\Delta C/C = 1 \times 10^{-8}$ may be measured with an uncertainty of 1×10^{-9} if the change occurs in 10 sec., and 2×10^{-9} if it occurs in 1 min. L. H.

See also Abstracts 4793, 4808, 5012, 5254.

ELECTROCHEMISTRY.

5214. Voltages of the Bismuth Oxides and the Alkali-Bismuth Accumulator. E. Baur and W. Lattmann. *Zeits. f. Elektrochem.* 40. *pp.* 582–585, *Aug.*, 1934.—In *N*-NaOH a Bi–Bi_2O_3 electrode has a voltage of − 0·41 volt. The curve relating voltage to the percentage of O in the electrode, obtained by using electrodes treated with potassium ferricyanide, persulphate, etc., shows the existence of Bi_4O_7, and Bi_2O_4, the voltages in *N*-NaOH being: Bi_2O_3, Bi_4O_7, + 0·51; Bi_4O_7, Bi_2O_4, + 0·62. No other compounds or solid solutions appear to exist at compositions between those of Bi_2O_3 and Bi_2O_4, but the nature of the system at higher O contents has not yet been determined. The cell Bi, Bi_2O_3 |*N*-NaOH|Bi_2O_4, Ni has a voltage of 1·035. The charge and discharge characteristics present certain difficulties, but further work on the possibilities of the cells as an accumulator appear to be justified. H. F. G.

5215. Cell Using the Energy of Oxidation of Alcohol. V. Karpen. *Comptes Rendus*, 199. *pp.* 708–710, *Oct.* 15, 1934.—The Becquerel acid-alkali cell works satisfactorily if methyl alcohol is added to the alkaline solution when by the catalytic action of the platinum anode the polarising oxygen oxidises the MeOH with formation of sodium formate. Details of the working of such a cell are given, showing that the energy of formation and neutralisation of formic acid is utilised. For satisfactory working the anodic current density must not exceed a certain limit, depending on the state of the surface of the anode, and of the solution, and especially on the temperature, the limit rising therewith. C. A. S.

5216. Temperature-Control Box for Saturated Standard Cells. E. F. Mueller and H. F. Stimson. *Bureau of Standards, J. of Research*, 13. *pp.* 699–704, *Nov.*, 1934.—In order to meet the need for a portable standard of e.m.f. somewhat better than the unsaturated standard cell, a semiportable temperature-control box for a group of saturated cells was constructed, and is described here. The apparatus provides an adequate solution for the problem of maintaining a working standard of e.m.f. for those purposes for which the unsaturated cell is not good enough. AUTHORS.

5217. Electrolysis of Saline Solutions by Means of Electrodes in Distilled Water. P. Jolibois. *Comptes Rendus*, 199. *pp.* 706–708, *Oct.* 15, 1934.—The electrolyte is poured (by means of a syphon with tap and entrance funnel at its highest point) into the bottoms of two beakers so as to form layers below water already therein, the electrodes (Pt) are inserted in the water. With a p.d. of 300 V. and a solution of $CuSO_4$, hydrated copper oxide, at first colloidal, is deposited at the surface of separation between the solution and the water; this is brought by cataphoresis towards the kathode, where it is not reduced to metal. This can be stopped by enclosing the kathode in a porous diaphragm, when with solutions of salts of Cu, Ni, Ag, Zn, Mg, U, and Th deposits of the hydrated oxide are obtained on the diaphragm: with a solution of $NaNO_3$ one of HNO_3 is obtained in the anodic beaker. C. A. S.

5218. A.C. Electrolysis of Sodium Carbonate and Bicarbonate Solutions. J. W. Shipley. *Canad. J. of Research*, 11. *pp.* 539–546, *Oct.*, 1934.—The a.c. electrolysis of sodium carbonate solutions at voltages as high as 110, even when arcing occurs on the electrodes, does not cause the evolution of CO_2. In the a.c. electrolysis of aqueous bicarbonate solutions with platinum electrodes, H_2, O_2 and CO_2 are evolved freely until all the bicarbonate has been transformed to carbonate, after which the evolution of CO_2 ceases and only H_2 and O_2 are given off. In a.c. electrolysis of sodium bicarbonate solutions and solutions of the sodium salts of aliphatic acids, a deposit of finely divided platinum is formed on the electrodes. This deposit inhibits the evolution of CO_2, H_2 and O_2, but does not affect the current flow. The decomposition potential of bicarbonate solutions in respect to the evolution of CO_2 on smooth platinum and with d.c. was found to be 2·2 volts, and of carbonate solutions, 3·5 volts. The anodic discharge potential of HCO_3^- is $-1\cdot45$ to $-1\cdot50$ volts, and of $CO_3^{=}$, $-1\cdot90$ to $-1\cdot95$ volts. The evolution of CO_2 does not appear to cause any polarising effect on the anode. AUTHOR.

5219. Influence of Temperature on the Electrolysis of Acetate Solutions. J. Robertson. *Faraday Soc., Trans.* 30. *pp.* 1007–1017, *Nov.*, 1934.—Electrolysis of acetates in non-aqueous solvents gives products which vary very little with temperature and anode material. With water present in the solvent the products depend on temperature and on anode material. In the electrolysis of aqueous solutions at platinum electrodes the current is distributed in three main reactions, ethane formation, oxygen formation and complete oxidation. At low temperatures ethane is the main product. The yield falls off with rise in temperature and complete oxidation increases to a maximum. Free oxygen now appears. With a further rise in temperature the ethane yield becomes practically zero, complete oxidation decreases and free oxygen increases. An explanation of the course of the reaction is suggested on the basis of the "discharged ion" theory. The "oxidation" theory does not explain the results. Higher ethane yields are obtained at higher temperatures by the use of more concentrated solutions. Increase in the current density also brings about increased yields. This is equivalent to the removal of part of the solvent. The products derived from electrolysis of aqueous solutions at different anodes are also discussed. The influence of anode material is not so marked the more concentrated the solution electrolysed. AUTHOR.

5220. Factors in Electrolytic Dissociation and the Energy of Dissociation of Salt Molecules. W. J. C. Orr and J. A. V. Butler. *Phil. Mag.* 18. *pp.* 778–792, *Nov.*, 1934.—Salts of ions having the rare gas structure are strong electrolytes in water and similar solvents; salts of metal ions of the transition series are frequently weak electrolytes even in water. Calculations show that the main origin of the difference of the two groups of salts is divergence of the salts of the latter group from the simple ionic structure, *i.e.* to their homopolar nature. J. S. G. T.

5221. Electrolytic Valve Action in Fused Salts. H. Grünert. *Zeits. f. Physik*, 91. 1–2. *pp.* 49–69, *Sept.* 19, 1934.—The forming conditions for Ta and Al in four different fused salts are investigated. The proportionality between the forming potential and the thickness of deposit holds here as for aqueous solutions. The blocking-layer grows at different rates in the different solutions but is less marked at higher temperatures. The relationship between absolute temperature and thickness of blocking-layer is found graphically to be: $\delta = A.T.^2 e^{-B/T}$. The results of the experiments are discussed quantitatively and qualitatively. The salts used were: $NaNO_3$, KNO_3, $KNO_3 + NaNO_3$ (eutectic mixture), and $K_2Cr_2O_7$. The limits for valve action are found to be between 500° C. and 600° C. H. L. B.

5222. Anodic Behaviour of Thallium in Certain Solutions. O. Pip. *Zeits. f. Physik*, 91. 5–6. *pp.* 329–335, *Oct.* 5, 1934.—The anodic behaviour of Tl is investigated at different voltages and in solutions of HF, HCl, HBr, HI and the corresponding Na salts. Only in HCl, HBr, NaCl and NaBr is the formation of a high-resistance surface film of anodically produced salt found to occur. The possibility of formation of the film is considered to be related to the deposition voltage of the anion. The potential at which the films break down with sparking is found to be relatively low (20 to 140 volts) and to depend upon the nature and concentration of the electrolyte. The influence of diffusion away from the anode is investigated by using a rotating electrode and the behaviour of some Tl alloys is also described. L. A. W.

5223. Oxidation-Reduction Potentials in Non-Aqueous Solutions. Part I. J. R. Partington and J. W. Skeen. *Faraday Soc., Trans.* 30 *pp.* 1062–1071, *Nov.*, 1934.—Measurements of the oxidation-reduction potentials of the systems cuprous and cupric chlorides and ferrous and ferric chlorides in anhydrous pyridine show that Peters' formula applies, as in the case of aqueous solutions. The potential at the electrode apparently arises without the intervention of the solvent, the electrode metal taking part solely in the transfer of electrons between the ions of different valency. AUTHORS.

5224. Potentiometric and Conductometric Studies. J. Pieper. *Zeits. f. Elektrochem.* 40. *pp.* 793–805, *Nov.*, 1934.—A discussion is first given of the methods for end-point determinations in potentiometric titrations, wherein the conclusions of Hahn and Weiler are shown to be invalid; the influences of different sources of error are considered. Previous work on Sb electrodes is reviewed, and it is shown that alkali-acidimetric titrations of strong electrolytes by the triodometer may be carried out potentiometrically with good success. As indicated electrodes, rods of previously treated and untreated cast antimony may be used, or Pt and Cu rods electrolytically coated with Sb, together with pure platinum foil. Copious experimental details are included. The titrations of NaOH with HCl, of HCl with NaOH, of H_2SO_4 with NaOH, and of Na_2CO_3 and mixtures of NaOH and Na_2CO_3 with HCl are investigated and the difficulties discussed. It is established that oxidation-reduction reactions as well as precipitations may be quantitatively determined with the triodometer. H. H. Ho.

See also Abstracts 4789, 4994, 4995, 5125.

ELECTRONS, POSITRONS AND PROTONS.

5225. Annihilation of Fast Positrons by Electrons in the K-Shell. H. J. Bhabka and H. R. Hulme. *Roy. Soc., Proc.* 146*A*. *pp*. 723–736, *Oct*. 15, 1934.—The rate of annihilation of fast positrons by electrons in the K-shell is considered. The probability of a stimulated transition of an electron from the K-shell to a state of negative energy is calculated for the condition where all the states of negative energy are unoccupied. From this can be calculated the probability of the corresponding spontaneous transition when only certain of the negative energy states are unoccupied, namely, those represented by the beam of positrons. The Dirac wave functions for an electron in the presence of a nucleus are used, but a closed formula can be obtained only if we treat Z/137 as small, Z being the atomic number, and further assume that $|E| \gtrsim 2mc^2$, where E is the energy of the positrons. Results for various elements are given for $|E|/mc^2 = 2$, and 100, and it is found that for large values of $|E|$ the absorption is given by $\sigma = \text{const. } Z^5/|E|$. The probability of annihilation is always very small compared with the probability of annihilation by free electrons, where two quanta are emitted. AUTHORS.

5226. Born's Theory of the Electron. J. Frenkel. *Roy. Soc., Proc.* 146*A*. *pp*. 930–934, *Oct*. 15, 1934.—The formula of Born and Infeld for the mass and the equations of motion of an electron are derived by a direct method which avoids the variation principle used by these authors. AUTHOR.

5227. Mass Variation of Electrons in Rapid Kathode Rays. H. Starke and M. Nacken. *Ann. d. Physik*, 21. 1. *pp*. 67–88, *Oct*., 1934.—The ratio of the longitudinal mass $\bar{\mu}$, of the transverse mass μ and of the kinetic mass (μ) to the stationary mass μ_0 of an electron for various velocities is found to have different values when calculated on the theories of Abraham and of Lorentz. These differences are shown in tabular form for a considerable range of velocities and the results given by the two theories are discussed. It appears that the differences do not increase indefinitely with increasing electron velocity, but reach a maximum for a velocity corresponding to a ray potential of about 500 kV. The ratio of the transverse mass to the kinetic mass, $\mu/(\mu)$, is found to differ from unity more and more the greater the velocity, both theories giving practically identical results. Measurements of ray deflection and ray potential consequently do not afford a means of deciding between the two theories. A. W.

5228. Interpretation of e^2/mc^2 and h/mc. B. Podolsky. *Phys. Rev.* 46. *pp.* 734–738, *Oct.* 15, 1934.—In this paper a point of view is presented according to which the quantities m and e, the mass and the charge of elementary particles, need not enter into the electrodynamics and the quantum mechanics of electrons, positrons and photons. The only constants entering into the equations, rewritten in this way, are the velocity of light and two independent lengths, namely: $a = e^2/mc^2$, and $b = h/mc$. The first of these lengths determines the scale of electrodynamic phenomena, and has no especial relation to electronic radius. The second determines the scale of quantum-mechanical phenomena. In the absence of particles electromagnetic phenomena have no definite scale. This fact, together with the possibility of creation of electron-positron pairs, leads to the belief that a theory of interactions of electrons, positrons, and photons, giving as a by-product a derivation of the ratio $a/b = \alpha = e^2/hc$, could be formulated without introducing the two other pure numbers $\gamma = m/M$ and $\beta = Gm^2/e^2$. This theory is envisaged as a limiting theory, obtainable from the future general theory by putting $\beta = \gamma = 0$. It is then considered from the point of view of the necessity of giving up space-time framework for the description of physical phenomena. It is concluded that the first limiting theory should not necessitate abolition of space and time. AUTHOR.

5229. Collisions of Slow Electrons with Atoms. Part IV. H. S. W. Massey and C. B. O. Mohr. *Roy. Soc., Proc.* 146*A*. *pp.* 880–900, *Oct.* 15, 1934.—A quantitative account is given of the effect of two factors which are of importance in determining the scattering of slow electrons by atoms. The first section discusses the form of the angular distribution of inelastically scattered electrons as determined by the distortion of the incident and outgoing electron waves by the field of the atom. The numerical application of the formulæ to Ne and A shows good agreement with the observed diffraction effects. In the second section the effect of the disturbance of the atomic field by the colliding electron on the elastic scattering is dealt with, and this theory is applied numerically to the scattering by H and He. Comparison with experiment then shows that the marked excess of scattering observed at small angles above that given by Born's approximation is clearly due to this polarisation effect. A summary of the present position of the theory of the scattering of slow electrons is also given. [For Part III, see Abstract 3800 (1933).] AUTHORS.

5230. Effect of Exchange on the Polarisation of Electrons by Double Scattering. R. A. Smith. *Cambridge Phil. Soc., Proc.* 30. *pp.* 520–523, *Oct.* 30, 1934.—Mott has shown by using Dirac's relativistic equation for the polarisation of beams of electrons by double scattering that a 15 % asymmetry is to be expected in the case of beams of 140 kV electrons scattered twice at 90° by gold. Experiments by Dymond show that there cannot be more than 1 % symmetry. The author investigates whether the exchange between the incident electron and the electrons of the struck atom may account for the discrepancy. The problem is dealt with unrelativistically, Schrödinger electrons being used. Exchange scattering is shown to be only a few per cent of the direct nuclear scattering. It is not expected that the relativistic treatment would give a very different result. The discrepancy between theory and experiment therefore remains. H. L. B.

5231. Diffraction of Electrons as a Search for Polarisation. F. E. Myers, J. F. Byrne and R. T. Cox. *Phys. Rev.* 46. *pp.* 777–784, *Nov.* 1, 1934.—Electrons accelerated by voltages from 80 kV to 225 kV passed through a thin homogeneous foil of polycrystalline gold and formed a diffraction pattern on a fluorescent screen. Through a hole in the screen, various rays of the diffracted beam were made in turn to fall on a second diffracting foil similar to the first. The second diffraction pattern was obtained on a photographic plate and examined for any asymmetry that might be caused by polarisation of the electron beam. After certain asymmetries in the apparatus were corrected, no asymmetry was found in the diffraction pattern. By interposing a vane for a given fraction of the time of exposure over part of the plate, a partial calibration of the plate could be obtained directly. It was estimated that if there was any asymmetry at all, it was certainly not above 10 % and probably not above 5. From this result and the observations of other workers at voltages from 100 kV down, it seems safe to conclude that diffraction is wholly, or largely, ineffective in polarising electrons with energies at any rate below 225 kV. This conclusion may be at variance with those of Rupp [see Abstract 2187 (1934)] on double scattering and on scattering and diffraction of an electron beam. The relation of these different experiments is discussed. AUTHORS.

5232. Diffraction of Electrons by Oxide Films on Molten Metals. J. A. Darbyshire and E. R. Cooper. *Faraday Soc., Trans.* 30. *pp.* 1038–1048, *Nov.*, 1934.—Oxide films removed from the surfaces of molten Cd, Bi, Mg and Al have been examined by electron diffraction. Discrepancies which could not be attributed to orientation have been found between the calculated and observed intensities of the diffraction rings. On all the CdO photographs there was an extra ring ($d/n = 1\cdot735$) which could not be attributed to either CdO or Cd. The experiments indicate that there are some features in connection with the optics of electron diffraction which are not allowed for on present theory. F. C. C.

5233. New Method for Determining the Electron Diffraction Patterns Produced by Thin Films. W. Cochrane. *Phil. Mag.* 18. *pp.* 956–970, *Nov.*, 1934. *Supplement.*—An electrical method of detecting the diffraction of kathode rays by thin films is described. The results obtained from films of celluloid, gold, aluminium and silver are given, and the experimental values for the intensities are found to agree with those given by Born's theory. AUTHOR.

See also Abstracts 4780, 4794, 4872, 5132, 5193.

ELECTROSTATICS.

5234. Electrical Point Actions with Spherical Conductors of Atomic and Sub-Atomic Magnitude. A. Upmark. *Zeits. f. Physik*, 91. 11–12. *pp.* 737–741, *Oct.* 23, 1934.—If a macroscopic spherical conductor is brought into an electric field it assumes the potential of the field at the point with which its centre coincides. When removed from the field it carries no charge with it. Its behaviour is quite different if it is furnished with a sufficiently long conducting point. By means of the projecting point it takes electricity out of the field. It becomes charged. With a conductor of atomic or sub-atomic order of magnitude each part of its surface acts as a point. It is shown that by this sort of action equilibrium takes place between oppositely charged conductors, without their touching each other. On this phenomenon the author bases an electrostatic theory of atomic structure. J. J. S.

5235. Law of Charge of a Spherical Particle in an Ionised Field. M. Pauthenier and L. Agostini. *Comptes Rendus*, 199. *pp*. 705–706, *Oct*. 15, 1934.—When a small sphere falls for a time t in a constant electric field, the fraction of the charge which could be gained by the ball [see Abstract 4463 (1932)] is $\lambda = t/(t + \tau)$, where $\tau = 1/\pi\kappa\rho$, κ is the mobility of the ions and ρ the density of the space charge. The field is produced by a wire carrying a negative potential stretched along the centre of an earthed cylinder of 40 cm. dia. A steel ball falls through a tube of insulating material placed at a constant distance from the centre. The law is found to be correct to within 3 % when the velocity of the sphere is half that of the ions. H. M. B.

See also Abstract 4776.

GALVANOMAGNETIC AND THERMOMAGNETIC EFFECTS.

5236. Hall Effect in Crystalline Media. M. Kohler. *Ann. d. Physik*, 20. 8. *pp*. 878–890, *Sept*., 1934.—By restricting the theory to cases in which the Hall effect is a linear function of the magnetic field strength, it is found possible to obtain, for symmetrical crystals, a satisfactory dependence of the Hall coefficient on the crystallographic orientation of the electric current and magnetic field strength. In this way it becomes possible to explain the results obtained by Verleger for Bi-crystals. R. W. P.

5237. Resistance Changes in Crystalline Media in Magnetic Fields. M. Kohler. *Ann. d. Physik*, 20. 8. *pp*. 891–908, *Sept*., 1934.—The dependence of the change of resistance on the crystallographic orientation of the current and magnetic field strength is investigated theoretically for cases in which the resistance change is proportional to the square of the magnetic field strength. The results are compared with the experimental results of Stierstadt for three types of single crystals of Bi which were investigated at low field strengths. An explanation is obtained for several of his results, but not all, and it is considered that even at these small field strengths the proportionality of the resistance to the square of the magnetic field strength may not hold. R. W. P.

5238. Thermal and Electrical Conductivities of Bismuth Single Crystals in a Magnetic Field. M. T. Rodine. *Phys. Rev*. 46. *pp*. 910–916. *Nov*. 15, 1934.—The thermal and electrical conductivities of two specimens of Bi single crystals were determined as a function of temperature and orientation of magnetic field relative to their crystallographic axes. These effects were observed at temperatures ranging from − 170° C. to − 50° C. The first specimen was mounted with its trigonal axis P $\perp$ to H and $\parallel$ to heat or current flow. The second specimen was mounted with P $\perp$ to heat or current flow and P $\perp$ or $\parallel$ to H. In this specimen it was also known that the heat or current flow was $\perp$ to the traces in the (111) plane formed by the intersection of the (111) and the $(11\bar{1})$ planes. A magnetic field of 7800 gauss was used and the crystallographic orientation was determined by means of variations in electrical resistance as the field was rotated about the specimen. For the first specimen, P $\parallel$ to heat and current flow, the decrease in thermal and electrical conductivity with the field perpendicular to any one of the binary axes was greater than when the field was parallel to any one of them. For the second specimen, P $\perp$ to heat and current flow, the decrease in thermal conductivity with H $\perp$ P was greater than the corresponding decrease with H ‖ P, whereas the decrease in electrical conductivity for these two positions were less and greater, respectively. AUTHOR.

See also Abstract 4851.

MAGNETISM AND ELECTROMAGNETISM.

5239. Derivation of the Magnetisation Function of Ferromagnetic Bodies Valid in the Whole Range of Temperature. H. Ludloff. *Zeits. f. Physik*, 91. 11–12. *pp.* 742–764, *Oct.* 23, 1934.—On the basis of the knowledge that the energy values of a ferromagnetic body behave quite analogously to the energy values of a van der Waals gas, that satisfies the statistic of Bose, a scheme may be formed, which passes over into Heisenberg's theory of ferromagnetism for high temperatures, and into Bloch's theory for low temperatures, and also permits a satisfactory exposition of the course of magnetisation in the middle temperature region of the two Curie points. J. J. S.

5240. Fundamental Equations of Electromagnetism, Independent of Metrical Geometry. D. van Dantzig. *Cambridge Phil. Soc., Proc.* 30. *pp.* 421–427, *Oct.* 30, 1934.—It is shown that Maxwell's equations are independent of any metrical relation so that no connection, affine or other, is needed to write them down. Matter is characterised by a bivector-density in this scheme. G. C. McV.

5241. Anomalous Magnetic Viscosity. A. Mitkevitčh. *Comptes Rendus de l'Acad. des Sciences, U.R.S.S.* 3. *pp.* 425–431, *Aug.* 21, 1934. *In English.*—It has been shown in previous papers by the author that magnetic viscosity depends largely on the magnetic history of the specimen tested and a method has been described for examining the factors concerned [see Abstract 3038 (1934)]. Some of the characteristic experimental data obtained by this method are given and anomalous behaviour under certain conditions is shown. Certain deductions are made from the results described. H. J. H. S.

5242. New K.S. Magnet Steel. K. Honda, H. Masumoto and Y. Shirakawa. *Tôhoku Univ. Sci. Reports*, 23. *pp.* 365–373, *Aug.*, 1934. *In English. Report No.* 325 *of the Research Inst. for Iron, Steel and other Metals.*—The magnetic properties of K.S. magnet steel are compared with those of tungsten steel and it is shown that the former is specially advantageous for magnets having a dimension ratio less than 10. The properties of the magnet steels prepared by Köster, Mishima and Kato are briefly described. It is suggested that the high coercive force of these steels is due to the fact that they consist of an aggregate of fine crystals. A new K.S. magnetic alloy which has a coercive force of about 850 gauss, a remanence of about 7,000, and contains 10–25 % Ni and 8–25 % Ti in place of Cr and W in K.S. steel is proposed; its magnetic and mechanical properties and behaviour on thermal treatment are given. H. J. H. S.

5243. Magnetic Effects in Iron Crystals. A. G. Hill. *Phil. Mag.* 18. *pp.* 539–545, *Oct.*, 1934.—A cylindrical crystalline shell was magnetised circularly by a current passing along its axis, and measurements were made at temperatures from − 190° to 312° C., using maximum fields of 520 gauss. It was found that (1) there are no discontinuities in the magnetisation curves obtained by summing the magnetisations in all directions in a face plane of an iron crystal; (2) there is a definite decrease with increasing temperature in the average values of the maximum induction, coercive force and residual magnetism; (3) there is a distinct decrease in the hysteresis loss with increase of temperature. From observations of magnetisation along a cubic axis it was found that self-demagnetisation reduces induction and hysteresis by a large factor, and the slopes of the curves vary linearly with temperature according to a given equation. Similar observations are made on a cylindrical shell of soft iron of the same dimensions as the crystal, and it is concluded that some method of obtaining unidirectional magnetisation uninfluenced by self-demagnetisation must be devised before the real existence of kinks in the curves can be recognised. [See Abstract 386 (1933).] G. E. A.

5244. Ferromagnetic Variety of Ferric Oxide. H. Forestier and G. Guiot-Guillain. *Comptes Rendus*, 199. *pp.* 720–723, *Oct.* 15, 1934.—This is obtained from Fe_2O_3,4BeO (which is prepared by adding in the required proportions $Fe(NO_3)_3$ and $Be(NO_3)_2$, or the chlorides, to aqueous NH_3) by dissolving out the BeO with dilute HCl. The most strongly magnetic product is obtained by heating Fe_2O_3,4BeO for 6 min. at 720°, which apparently causes decomposition to Fe_2O_3 and BeO. It is much more strongly magnetic than any other variety of Fe_2O_3, with Curie point at 220°. Prolonged heating above 700° destroys the magnetism with conversion to ordinary Fe_2O_3. X-ray examination shows the new variety to be a slightly deformed rhombohedral Fe_2O_3 [see Abstract 1389 (1932)]. C. A. S.

5245. Susceptibilities of Sulphates of Magnetic Metals. E. F. Herroun. *Phys. Soc., Proc.* 46. *pp.* 872–881, *Nov.* 1, 1934.—It has been recognised for many years that the molecular susceptibility of many salts, particularly sulphates, is greater in the hydrated than in the anhydrous condition. Measurements of susceptibility for anhydrous and hydrated single and double salts have shown that the increase is not a specific property of water but that when potassium or ammonium sulphate is substituted for the " water of constitution " there is an increase in molecular susceptibility. With the sulphates of iron, cobalt and nickel this increase is greater than that due to a molecule of water. With manganese sulphate the difference is small but in the same direction but with copper sulphate a molecule of water increases the susceptibility to a greater extent than a molecule of potassium or ammonium sulphate. An increase in susceptibility after heating has been found, but in certain salts this is complicated by the fact that hydrolysis or oxidation occurs with the production of basic salts or oxychlorides which also cause an increase in susceptibility. Cobalt pyrophosphate appears to be stable when heated in air to 600° C. and exhibits an increase in susceptibility free from complications. AUTHOR.

5246. Transient Phenomena and Propagation of Large Magnetic Discontinuities. F. Hülster. *Zeits. f. techn. Physik*, 15. 10. *pp.* 387–391, 1934.—The author's previous work [see Abstract 766 (1933)] is concluded. The distribution of the discontinuity time in the region of small fields assumes several different characteristic forms. Three definite types are distinguished and the relation which these bear to the other magnetic properties of the material is discussed. The significance of a study of the propagation of discontinuities is shown to be of importance in the explanation of the distribution of discontinuity times. Various anomalous effects in propagation are described. H. J. H. S.

5247. Diamagnetism of Organic Liquid Mixtures at Different Temperatures. S. R. Rao and P. S. Varadachari. *Indian Acad. Sci., Proc.* 1*A*. *pp.* 77–97, *Aug.*, 1934.—The diamagnetic susceptibilities of mixtures of benzene-acetone, chloroform-acetone and nitrobenzene-acetone have been studied at different temperatures ranging from 15° C. to 50° C., using the Quincke method with very large magnetic fields. Explanations are offered to the anomalous results obtained by different investigators. The susceptibilities of these mixtures obey the additive law in this range of temperature. Further the pure liquids do not show any variation in their susceptibility values between 15° C. and 50° C. The additive law of mixtures is true unless chemical combination in the mixture changes entirely the nature of the bonds linked to the carbon atom. [See Abstracts 3922 and 3923 (1934).] AUTHORS.

5248. Magnetism of Tin. S. R. Rao. *Indian Acad. Sci., Proc.* 1*A. pp.* 123–142, *Sept.*, 1934.—The magnetic susceptibility of colloidal tin is investigated by the Curie method. White tin *en masse* is found to have a susceptibility of 0·360. On heating the metal this susceptibility remains constant up to 220° C. At the melting point (233° C.), this value decreases rapidly to $-$ 0·0455. On cooling to 30° C., the metal regains the value of $+$ 0·0360. A sample of pure white tin powder was carefully sorted out by settling in propyl alcohol and centrifuging. On testing the colloidal powders magnetically, it was found that as the particle size decreases, the susceptibility becomes diamagnetic, this diamagnetism attaining larger values at smaller particle sizes. On melting and recrystallising, the substance becomes once again paramagnetic. Careful tests showed that these results could not be due to chemical or ferromagnetic impurities. A large amount of evidence, both theoretical and experimental, is presented to show that the paramagnetic susceptibility of white tin is not an atomic property but is dependent on the crystal structure of the metal. The atomic susceptibility of tin is nearly the value $-41\cdot54 \times 10^{-6}$ found experimentally for grey tin. AUTHOR.

5249. Absolute Measurement of the Coefficients of Magnetisation and Magnetic Susceptibilities of Liquids. G. Dupouy and C. Haenny. *Comptes Rendus*, 199. *pp.* 781–783, *Oct.* 22, 1934.—A modification of the Gouy cylinder method is described. The apparent susceptibility of an immersed, specially cut quartz rod is measured relative to the liquid, and the susceptibility of the rod being known, that of the liquid can be calculated. The advantages of the method are described. [See following Abstract.] N. M. B.

5250. Paramagnetic Properties of Cerous Salt Solutions. C. Haenny and I. G. Dupouy. *Comptes Rendus*, 199. *pp.* 843–845, *Oct.* 29, 1934.—A recently reported method of measuring the magnetisation coefficients of liquids [see preceding Abstract] is applied to the study of the paramagnetic properties of aqueous and alcoholic solutions of cerous nitrate, chloride, and acetate, of various concentrations over an approximate temperature range of 20° to 70° C. The magnetisation coefficient is inversely proportional to the temperature, and the Curie-Weiss law is obeyed. The calculated magnetic moment is 5/2. N. M. B.

5251. Dependence of Magnetic Susceptibility of Water and Aqueous Solutions of KI on Temperature. G. Tammann. *Zeits. f. Physik*, 91. 5–6. *pp.* 410–412, *Oct.* 5, 1934.—The susceptibilities of these substances are shown to be related to the changes in the molecular composition of water with temperature and to the effect of the added salt. The increase of susceptibility due to addition of KI at 20° C. is proportional to the decrease in the concentration of the molecular ice-form I. G. E. A.

5252. Dependence of the Diamagnetism of Water upon its Temperature. A. P. Wills and G. F. Boeker. *Phys. Rev.* 46. *pp.* 907–909, *Nov.* 15, 1934.—The anomalous results described in a previous communication [see Abstract 1210 (1933)] are explained in part, and the results of recent experiments relating to the dependence of the specific susceptibility (χ) of water upon its temperature are given. For the temperature range from 20° C. to 66° C. these results are represented with fair approximation by the parabolic formula: $\chi/\chi_{20} = 1 + 1{\cdot}3 \times 10^{-4} (T - T_{20}) - 0{\cdot}7 \times 10^{-6}(T - T_{20})^2$. A comparison is made of the results obtained with those found by previous observers. AUTHORS.

5253. Diamagnetic Susceptibilities of Salts Forming Ions with Inert Gas Configurations. Part I. Halides of Sodium and Potassium. F. E. Hoare. *Roy. Soc., Proc.* 147*A*. *pp.* 88–100, *Nov.* 1, 1934.—The diamagnetic susceptibilities of the Na and K halides have been measured by Gouy's method between the temperatures of 20° C. and 22° C. The salts were used in the crystalline state, and their susceptibilities evaluated by comparison with the behaviour of water whose susceptibility was taken as $0{\cdot}72 \times 10^{-6}$ c.g.s. A correction has been applied for the volume of the liquid meniscus. Neglect of this correction introduces an error of as much as 3 %. Two specimen tubes, and at least four different specimens of each salt were used. Special precautions were taken to ensure the same location of the specimen tubes throughout the experiments. The average deviation of the results from the mean values is approximately 0·5 % and this figure probably represents the limit of accuracy of the method. AUTHOR.

5254. Electrodynamics of a Moving Body. W. Bünger. *Ann. d. Physik,* 20. 7. *pp.* 773–779, *Sept.*, 1934.—A special bridge method is described by means of which comparisons of capacity could be made with an accuracy of the order of 10^{-9}. Arrangements were made permitting the testing apparatus to be oriented at any angle to the earth's path and systematic measurements were made extending over six months. The results obtained for $\Delta C/C$, ΔC denoting observed capacity variations, show that the capacity of a condenser is, to a few units in the ninth place of decimals, independent of its orientation with respect to the direction of the earth's velocity. A. W.

5255. Polar Form of the ker and kei Functions, with Applications to Eddy-Current Heating. N. W. McLachlan and A. L. Meyers. *Phil. Mag.* 18. *pp.* 610–624, *Oct.*, 1934.—In solving problems relating to eddy-current losses in straight cylindrical wires, tubes and the like it is convenient to introduce Kelvin's ber and bei functions. These are generally used in cartesian form, but in many cases the polar form is preferable. Formulæ are here obtained by means of which, making use of the tables of the ker and kei functions given in the British Association Report for 1915, tables of the polar functions have been calculated for $Z = 0$ to 10 at intervals of 0·1. The use of the polar functions is illustrated by consideration of (*a*) eddy-current loss in a cylindrical tube situated in an alternating magnetic field; (*b*) the effective resistance of a solenoid due to a core; (*c*) the effective inductance of a toroid with a tubular core and (*d*) the impedance of a long cylindrical tube. A. W.

5256. Special Cases of Mutual Inductance between Circular Coils, with Practical Applications. F. H. Llewellyn. *Phys. Soc., Proc.* 46. *pp.* 824–840, *Nov.* 1, 1934.—This paper contains the results of some practical work on the mutual inductance between coils. It shows that equations relating to the ideal case of circular coils can be applied to multi-layered coils under conditions giving (*a*) constancy of the mutual inductance between a pair of twin coils connected in conjunction and a smaller coil sliding on a rod through the centre of symmetry O of the pair, for certain distances between the twin coils and certain angles made by the rod with their planes ; (*b*) proportionality between mutual inductance and displacement for the same coils if the twin coils are connected in opposition ; (*c*) proportionality between mutual inductance and angle if a large central coil is rotated about a diameter through the centre of symmetry O of a pair of twin coils, for certain conditions as to the distances between the twin coils and the ratios borne by the radius of the central coil to that of either of the twin coils ; and (*d*) proportionality between mutual inductance and the sine of the angle between a pair of twin coils and a solenoid rotating symmetrically between them, for given dimensions of the solenoid. The paper also gives a simple method for determining the absolute magnetic moment of a magnet, in which the need for corrections for the dimensions of the magnet is avoided. AUTHOR.

5257. Modulus of Torsion of Magnetised Ni at High Temperatures. W. Möbius. *Phys. Zeits.* 35. *pp.* 806–811, *Oct.* 15, 1934.—The work described in an earlier paper [see Abstract 3928 (1932)] is continued. Greater field strengths are employed and more accurate temperature measurements are made, particularly in the region of the Curie point. The period of a system oscillating in a magnetic field of varying strength is examined as a function of the temperature and the results given in a series of curves. An attempt is made to explain the observed results. H. J. H. S.

See also Abstracts 4794, 4849, 4884, 4948, 4950, 5192, 5194.

MEDICAL RADIOLOGY AND ELECTROLOGY.

5258. Physical Basis of the Biological Effects of High Voltage Radiations. W. V. Mayneord. *Roy. Soc., Proc.* 146*A*. *pp.* 867–879, *Oct.* 15, 1934.—The possible importance of the range of the secondary electrons produced in living materials by high-voltage X-rays and γ-rays is discussed. Using the Klein-Nishina formulæ, the total path of all the electrons set free per unit absorption is calculated and shown to rise rapidly in the γ-ray region of wave-lengths. Supposing one or more electron passages suffice to cause a biological change in a cell, the survival curves of a mass of cells irradiated with different wave-lengths are calculated. The differences in these survival curves according to the energy absorption required to cause the biological changes are discussed. AUTHOR.

5259. Processing X-Ray Films at High Temperatures. J. W. Farthing. *Radiology*, 23. *pp.* 438–442, *Oct.*, 1934.—In radiographic work, in hot weather, particularly in the United States, difficulty is practically experienced, in keeping developing photographic solutions at the standard temperature of 65° F. A formula is given which is suitable for use up to temperatures of 95° F., with restriction of the times of development, according to temperature, with no adverse effect upon the radiographic quality. The films so developed are fixed in a formalin fixing bath, to harden the emulsion. B. J. L.

5260. Cumulative Dose in Radiation Therapy. M. C. Reinhard and H. L. Goltz. *Radiology*, 23. *pp.* 166–169, *Aug.*, *and pp.* 285–289, *Sept.*, 1934.—In the therapeutic administration of X-rays and radium rays, there are two prime methods in use, namely, the method in which the tissues are saturated by a large single dose and the method in which small multiple doses are given over a varied period of time. Whilst by the first method a total irradiation of 1200 to 1500 r only can be given, by the second method a total dosage as high as 7800 r may be administered. On the basis of curves, analogous to practical treatment, it is shown that the total dose, with multiple small doses, is insufficient to specify the treatment, as besides the quality and intensity, information is required as to the interval between treatments and the increase of intensity with later treatments, which becomes necessary since, in course of time, the tissues become less sensitive to the radiation and, unless the dosage per treatment is increased, a state of equilibrium of the tissues is obtained when the loss of the effect of radiation per day, is not balanced by the increase of radiation per treatment, which necessitates an increase of dosage not less than 400 r. The above results only relate to when a single area is treated. When multiple ports of entry are used, the problem becomes more involved. It is not attempted to take into consideration the difference of quality of radiation at different depths of tissue from the surfaces of different ports of entry, which, in order to simplify the problem is considered as though the Compton effect is not present. The subject is discussed on the basis of curves, obtained under experimental conditions and it is again decided that a mere statement of the total dose given *via* various ports of entry, has no direct relationship to the actual effective dose. B. J. L.

5261. Possible Development in X-Ray Therapy. H. A. Jarre and R. F. James. *Radiology*, 23. *pp*. 483–485, *Oct*., 1934.—Methods of increasing the absorption of X-rays in living tissue, to increase the therapeutic value of the radiation, are generally discussed with reference to iontophoresis, the use of contrast agents and the use of fluorescent material, but, particularly, in respect to a method due to Hughes and Binz, by which a chemically stable iodine compound is introduced into the body tissues, which, under X-ray irradiation, liberates nascent iodine, by photochemical reaction. B. J. L.

5262. Dosage Measurements of Very Hard X-Rays. R. Jaeger. *Phys. Zeits*. 35. *pp*. 841–844, *Nov*. 1, 1934. *From the Reichsanstalt*.—Dosage measurements, with various types of ionisation chamber, have been made on the high-voltage X-ray set of the Berlin Frauenklinik der Charité. A parallel plate chamber with 25 cm. plate separation appears to be adequate for radiations produced at 500 kV with 3 mm. Cu filter (half value layer, 6 mm. Cu); it is predicted that a chamber of this size would be sufficient for radiations up to 10 mm. Cu half-value layer. This is in accord with the observation of Lauritsen, that the Compton electrons produced by 700 kV X-rays, and released in a 30 cm. Wilson chamber, are far more abundant than the photoelectrons, and have a range of 10 cm. in air. A thimble chamber of 1 mm. thick graphite, which had been proved to be independent of wave-length for softer radiations, is shown to be still independent of wave-length at 500 kV and 3 mm. Cu filter. The same applies to the cellophane walled "universal chamber," subject to the condition that all the secondary electrons from the surrounding medium are measured. It is concluded that for high voltage radiations so far produced the standard chamber is satisfactory, and that the small thimble chamber may be used, provided that the wall thickness exceeds the range of the secondary electrons produced. J. E. R.

5263. Bactericidal Effects of X-Rays. F. L. Mohler and L. S. Taylor. *Bureau of Standards, J. of Research*, 13. *pp*. 677–680, *Nov*., 1934.

—The effects of X-rays in liquids are localised in columns of ionisation along the path of each high-speed electron. It is assumed that biological effects are produced in these columns and experimental results of Wyckoff and Rivers on killing of colon bacilli by kathode rays and X-rays are expressed in terms of the effective collision area of the column and bacillus for killing. Kathode rays of 155 kV give an area of $0 \cdot 68 \times 10^{-10}$ cm.^{2} X-rays of wavelengths ranging from $0 \cdot 56$ to 4 Å give values between $0 \cdot 72 \times 10^{-10}$ and $2 \cdot 6 \times 10^{-10}$ cm.^{2} As the area of the bacillus is about 10^{-8} cm.^{2} passage of a column through the bacillus is in general not fatal. The column must pass through a particular point to cause death. AUTHOR.

5264. Recommendations by the X-Ray and Radium Protection Commission at the Fourth International Congress of Radiology, Zürich, July, 1934. *Brit. J. of Radiology*, 7. *pp.* 695–699, *Nov.*, 1934.

5265. Dosage System for γ-Ray Therapy. R. Paterson and H. M. Parker. *Brit. J. of Radiology*, 7. *pp.* 592–632, *Oct.*, 1934.—A practical system of dosage measurement is described, applicable to most forms of radium therapy. The international r unit is accepted as a satisfactory unit of quantity of γ-radiation and the Imc.Hr. of Sievert assessed as equal to $8 \cdot 4$ r. Graphs are given showing for various distances, the amount of radium required on any applicator to produce a dose of 1000 r over any desired area. Rules are suggested, defining how radium must be distributed upon such applicators to produce a reasonably uniform irradiation over a surface. The effects of given doses of γ-radiation on normal and malignant tissue are described. The problem is considered in detail for the cases of a ring applicator, plane circular applicator, and the plane rectangle. It is concluded that, in the general case, provided the radium has been correctly distributed, the intensity depends on the area of the applicator rather than the shape. The calculations are extended to a consideration of convex and concave applicators. J. E. R.

See also Abstracts 5079, 5080, 5100, 5101, 5102.

OSCILLATIONS.

5266. Inductive Glow-Discharge Oscillator and Its Uses. W. E. Kock. *Zeits. f. techn. Physik*, 15. 10. *pp.* 377–384, 1934.—In an oscillator using a glow-discharge lamp it is possible to produce distinct oscillatory conditions by the introduction of inductance into the circuit. The conditions for the production of oscillations of the first type are considered, it being found that damped oscillations and oscillations of constant amplitude are possible. The damped oscillations only have any practical use. Oscillations of the second type are also to be obtained with the same circuit and are found to be very stable. Uses of the second class oscillations are described in a sine-wave generator and an electric organ. The effects of a grid-controlled glow-discharge lamp are also briefly discussed. R. C. F.

5267. Amplification of Small A.C. Voltages by an Inductive Action of the Electrons in a Radio Valve. C. J. Bakker and G. de Vries. *Physica*, 1. *pp.* 1045–1054, *Oct.–Nov.*, 1934. *In English.*—The possibility of amplification is investigated both theoretically and experimentally when the anode is kept negative, so that the electrons in a valve cannot reach this anode, but approach it sufficiently near to induce considerable charges. The influence of the transit times is taken into account. Agreement of theory and experiment is satisfactory. AUTHORS.

See also Abstracts 4864, 4994, 4995, 5188.

PHOTOELECTRICITY.

5268. Energy Distribution of Photoelectrons as a Function of the Thickness of a Potassium Film. J. J. Brady. *Phys. Rev.* **46.** *pp.* **768–772,** *Nov.* **1, 1934.**—Current-voltage curves were taken for photoelectrons ejected from K films of various thicknesses, formed on a silvered glass surface at room-temperature by means of a molecular beam. The condensing surface was a small sphere placed at the centre of a large collecting sphere. The thickness of the film was computed from the geometry of the photocell, the temperature and time of heating of the K reservoir, and data on the vapour pressure of K. The small inner sphere was connected to an electrometer which measured the photocurrent. The contact potential between the film and the silvered surface of the large sphere was determined from the values of the thresholds of the two surfaces. The form of the curves near the maximum retarding potential was approximately the same for each film thickness. The curves were analysed by DuBridge's method and were in good agreement with the theory. For films less than 3 molecular layers corrections had to be made for a constant decrease in photocurrent after the formation of the film. However, for films of greater thickness the photocurrent was quite constant. The photocurrent for films less than 3 molecular layers failed to saturate for accelerating potentials up to 20 volts. As the film thickness increased the photocurrent began to saturate at lower voltages. AUTHOR.

See also Abstracts **4794, 4823, 4824, 4825, 4891, 4892.**

PIEZOELECTRICITY.

See Abstracts **5153, 5211.**

THERMIONICS.

5269. Measurement of Secondary Thermionic Emission by Shot Voltage. E. B. Moullin. *Roy. Soc., Proc.* **147***A. pp.* **100–118,** *Nov.* **1, 1934.**—This paper describes a technique for deducing the magnitude of secondary thermionic emission by measuring the "shot" voltage developed in a thermionic valve. The theory of shot effect is reviewed briefly, and the experimental method and its accuracy are discussed and illustrated by measurements of the electron charge, in conditions where secondary emission is absent, both in the presence and absence of space charge. The shot voltage is presumed to be proportional to the total rate of events occurring at the anode; hence if secondary emission is present it will give a measure of the sum of primary and secondary electrons agitating the anode circuit. The difference between the number of primary and secondary electrons is measured by the anode current. The sum is deduced from the shot voltage, and the difference from the anode current, and hence the magnitude of each component can be deduced. Some deduced curves of primary and secondary current are shown for two types of valve working in the dynatron condition. These curves appear to show that a complicated system of emission occurs when the grid and anode are nearly at the same potential. No serious attempt is made to discuss the unexpected features of the deduced curves. AUTHOR.

THERMOELECTRICITY.

See Abstract **5199.**